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**SECOND QUARTER 1992  
AMBIENT AIR MONITORING REPORT  
LIVINGSTON RAIL YARD**

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**SECOND QUARTER 1992  
AMBIENT AIR MONITORING REPORT  
LIVINGSTON RAIL YARD**

Submitted to:

**Montana Department of Health  
and Environmental Sciences**  
Cogswell Building  
Helena, Montana 59620

Submitted by:

**Burlington Northern Railroad Co.**  
9401 Indian Creek Parkway  
Overland Park, KS 66201

Prepared by:

**Envirocon, Inc.**  
P.O. Box 8243  
Missoula, Montana 59807

Submittal date:

**August 28, 1992**

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SEP 1 1992

Montana Department of Health  
and Environmental Sciences  
Solid and Hazardous Waste Bureau





## 1.0 INTRODUCTION

This document presents the results of Burlington Northern Railroad's (BNRR's) ambient air monitoring investigations conducted by Envirocon, Inc. during the second quarter of 1992 for the Livingston Rail Yard project, in Livingston, Montana. The purpose of ambient air monitoring is to assess the impact of existing site contamination and remedial activities on ambient air quality.

Ambient air monitoring data collection began on November 10, 1990. This quarterly report represents the period between April 1 and June 30, 1992. Measured parameters, defined by Section 14.4 of the Interim Remedial Measures Work Plan (IRMWP) (Envirocon, 1989), originally included PM10, TSP, metals, PNAs, and meteorology. In June of 1991, with MDHES' approval, the measured parameters were reduced to include PM10 and meteorology. The TSP, metal, and PAH results were discussed in the First Quarterly Ambient Air Monitoring Report (Envirocon, 1990). All results through March 31, 1991 are presented in the Draft Remedial Investigation Report (Envirocon, 1991).

The design and operation of the ambient air monitoring program are in accordance with the IRMWP, as amended. Envirocon is responsible for the equipment's daily operations. Bison Engineering, Inc. provides assistance by conducting audits, performing the laboratory work, and assisting with quarterly-report data preparation.





## **2.0 NETWORK CONFIGURATION**

### **2.1 Monitoring Locations - General**

The ambient air monitoring network consists of an upwind station and a downwind station. Each station contains a PM10 air monitoring instrument. The downwind station also contains meteorological equipment.

The upwind station measures ambient air quality upwind of all remedial activities. The downwind station is located to measure worst-case ambient air impacted by remediation activities. In addition, ambient air at the downwind station is impacted by current rail yard operations. Figure 1.0 shows the locations of both stations. The coordinate locations of these sites are shown on Table 1.0.

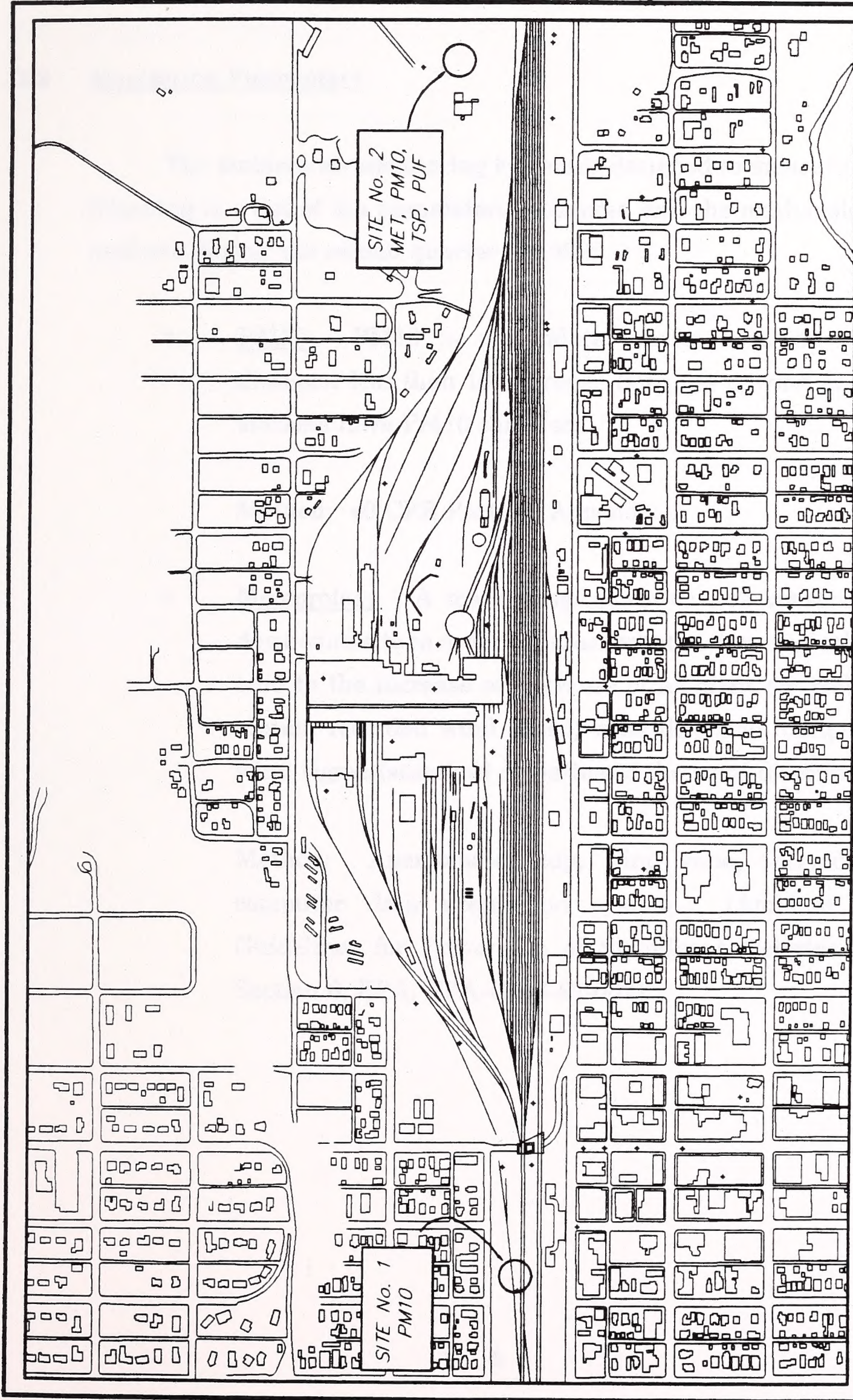
**Table 1.0**  
**Ambient Monitoring Locations**

<b>Station</b>	<b>UTM East</b>	<b>UTM North</b>	<b>North Latitude</b>	<b>West Longitude</b>
Upwind	334050	5056410	45° 38' 36"	110° 33' 26"
Downwind	335360	5057520	45° 39' 13"	110° 32' 47"

UTM ZONE = 12







<p>UPWIND &amp; DOWNWIND AMBIENT AIR MONITORING LOCATIONS</p>	<p>AMBIENT AIR MONITORING REPORT</p>	<p>BURLINGTON NORTHERN</p>	<p><b>ENVIROCON, INC.</b></p>
<p>FIGURE 1.0</p>	<p>140101</p>		<p>AutoCAD FILE: DM1.DWG</p>







## 2.2 Monitoring Parameters

The ambient air monitoring system is designed to measure PM10. The following is a list of the parameters measured and the methodology used for analysis during the second quarter of 1992:

- PM10 - PM10 is particulate matter with an aerodynamic diameter less than 10 microns. Both the upwind and downwind stations have PM10 samplers.

Method: 40 CFR Part 50, Appendix J

- Meteorology - A meteorological tower was constructed at the downwind site in order to assess what meteorological events may lead to the increase or decrease of ambient air pollutants. The station recorded wind speed, wind direction, temperature, and wind sigma (standard deviation of the wind direction).

Method: Anemometer cup, wind vane, thermocouple, and computer data acquisition system. (Ambient Monitoring Guidelines for Prevention of Significant Deterioration [PSD], Section 6, EPA, EPA-450/4-87-007).





### 2.3 Monitoring Frequency

The monitoring frequency for each parameter is shown on Table 2.0.

**Table 2.0**  
**Ambient Monitoring Frequency**

PM10	One-day-in-six, 24-hour sample Upwind and downwind stations
Meteorology	Continuous sampling Hourly data analysis Downwind station only





### 3.0 DATA SUMMARY

#### 3.1 PM10

Between April 1 and June 30, 1992, 14 PM10 samples, out of a possible total of 15 samples, were collected at the upwind station, and 12 PM10 samples were collected at the downwind station. PM10 data recovery completeness for this period was 93% at the upwind site and 80% at the downwind site.

The mean PM10 values for this period were 19 ug/m<sup>3</sup> at the upwind site and 18 ug/m<sup>3</sup> at the downwind site. The peak PM10 reporting values for the upwind and downwind sites were 36 and 39 ug/m<sup>3</sup>, respectively. These values are compared against the Montana ambient air quality standards on Table 3.0.

**Table 3.0 - PM10 Results vs Ambient Standards**

	Standard	Upwind Station	Downwind Station
Arithmetic Mean	50*	19	18
Peak	150**	36	39

Units: ug/m<sup>3</sup>

\* Annual mean

\*\* Not to be exceeded more than once per year.

Complete PM10 data and summary statistics are provided in Appendix A. The statistics include monthly means, yearly means to-date, geometric means, and standard deviations. Appendix B contains the results of calibrations and audits.





### 3.2 Meteorology

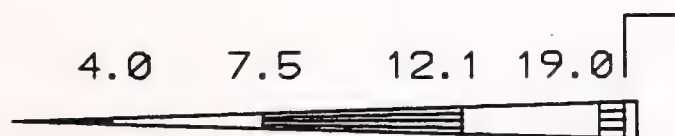
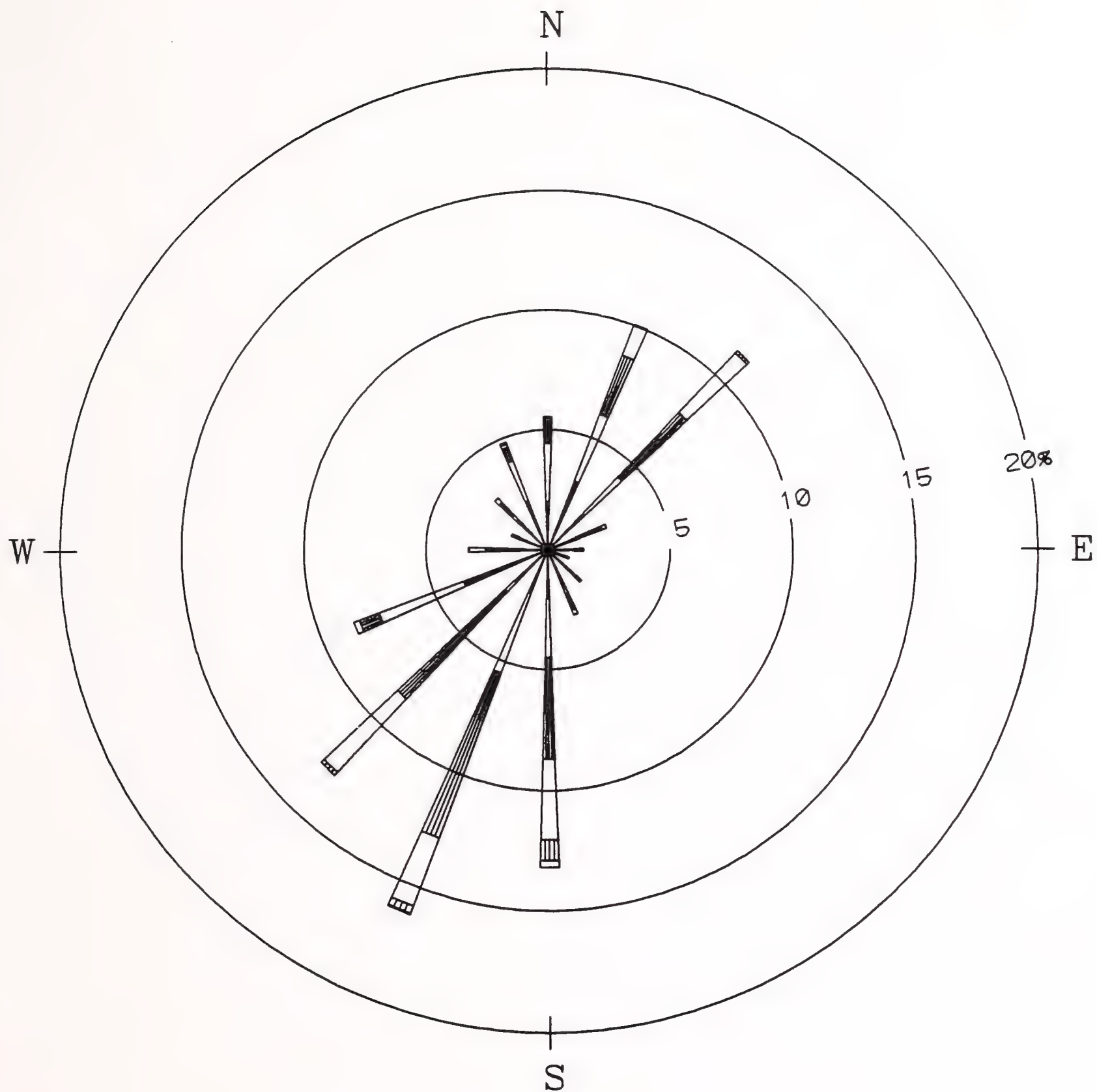
The meteorological station at the downwind site measures wind speed, wind direction, and temperature. Overall data recovery for the meteorological system was excellent during the second quarter of 1992, with 100% completeness.

Between April 1 and June 30, 1992, the average wind speed was 9.0 miles per hour, the resultant wind direction was 244 degrees, and the percentage of calm hours was 0.0 percent. The maximum temperature during this period was 87.5° Fahrenheit (F), the minimum temperature was 21° F, and the average temperature was 54° F.

Appendix A contains a complete listing of the meteorological information for wind speed, wind direction, wind sigma, and temperature. Appendix A also contains monthly and seasonal (to-date) wind frequency distribution data. Wind roses are shown on Figures 2.0 through 5.0.







Wind Speed Class Boundaries  
(Miles/Hour)

NOTES:

Diagram of the Frequency of  
Occurrence for each Wind Direction.  
Wind Direction is the Direction  
From Which the Wind is Blowing.

## WINDROSE

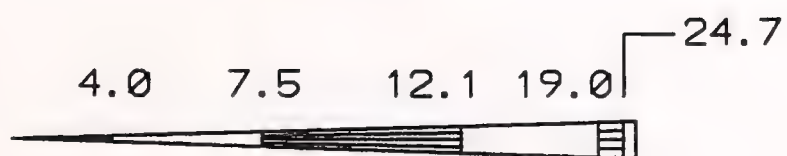
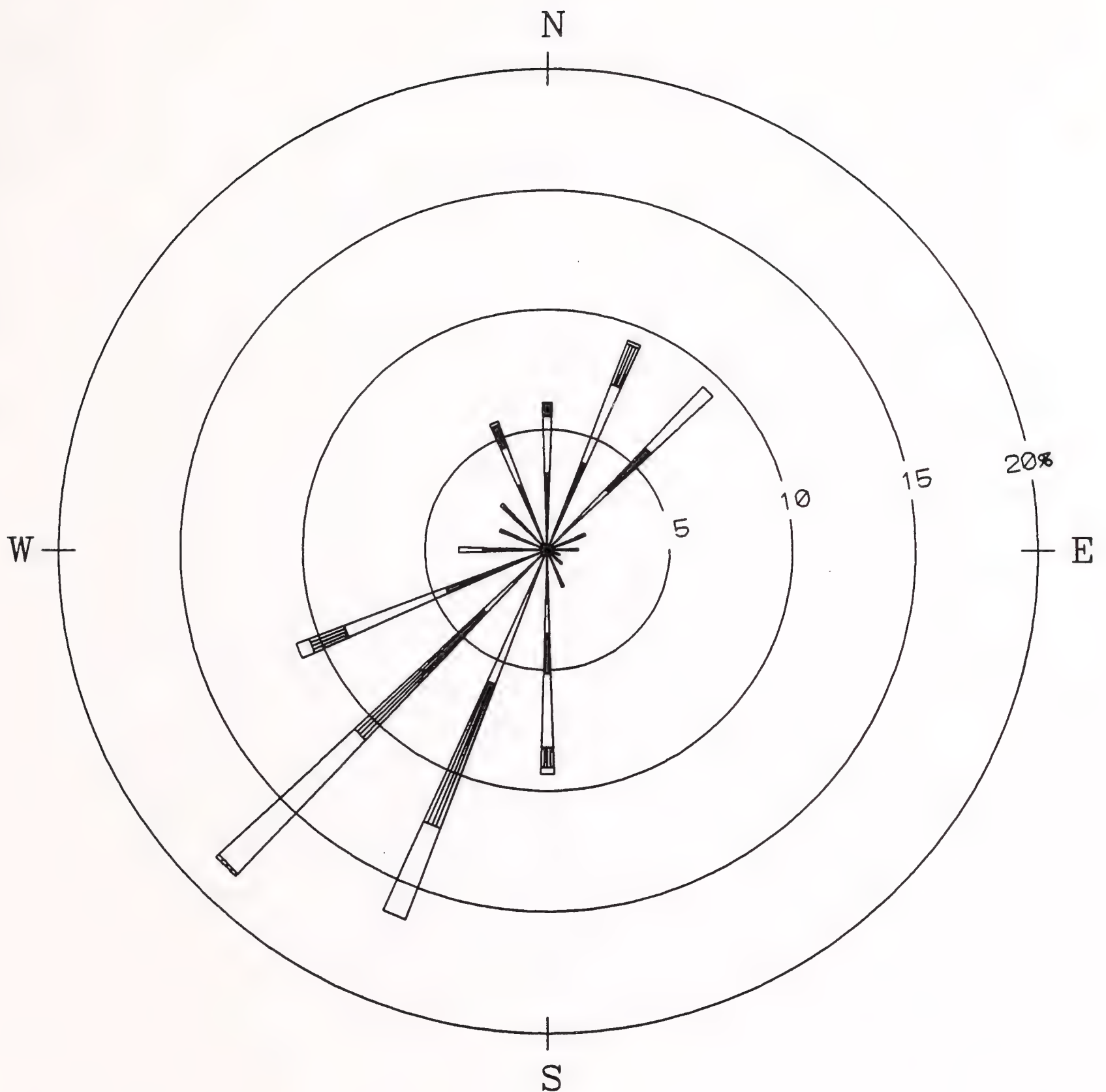
Livingston, MT

PERIOD: 2nd Q 1992

Btson  
Engineering

Figure 2.0





Wind Speed Class Boundaries  
(Miles/Hour)

NOTES:

Diagram of the Frequency of Occurrence for each Wind Direction. Wind Direction is the Direction From Which the Wind is Blowing.

# WINDROSE

Livingston, MT

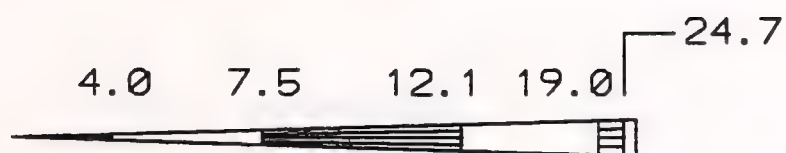
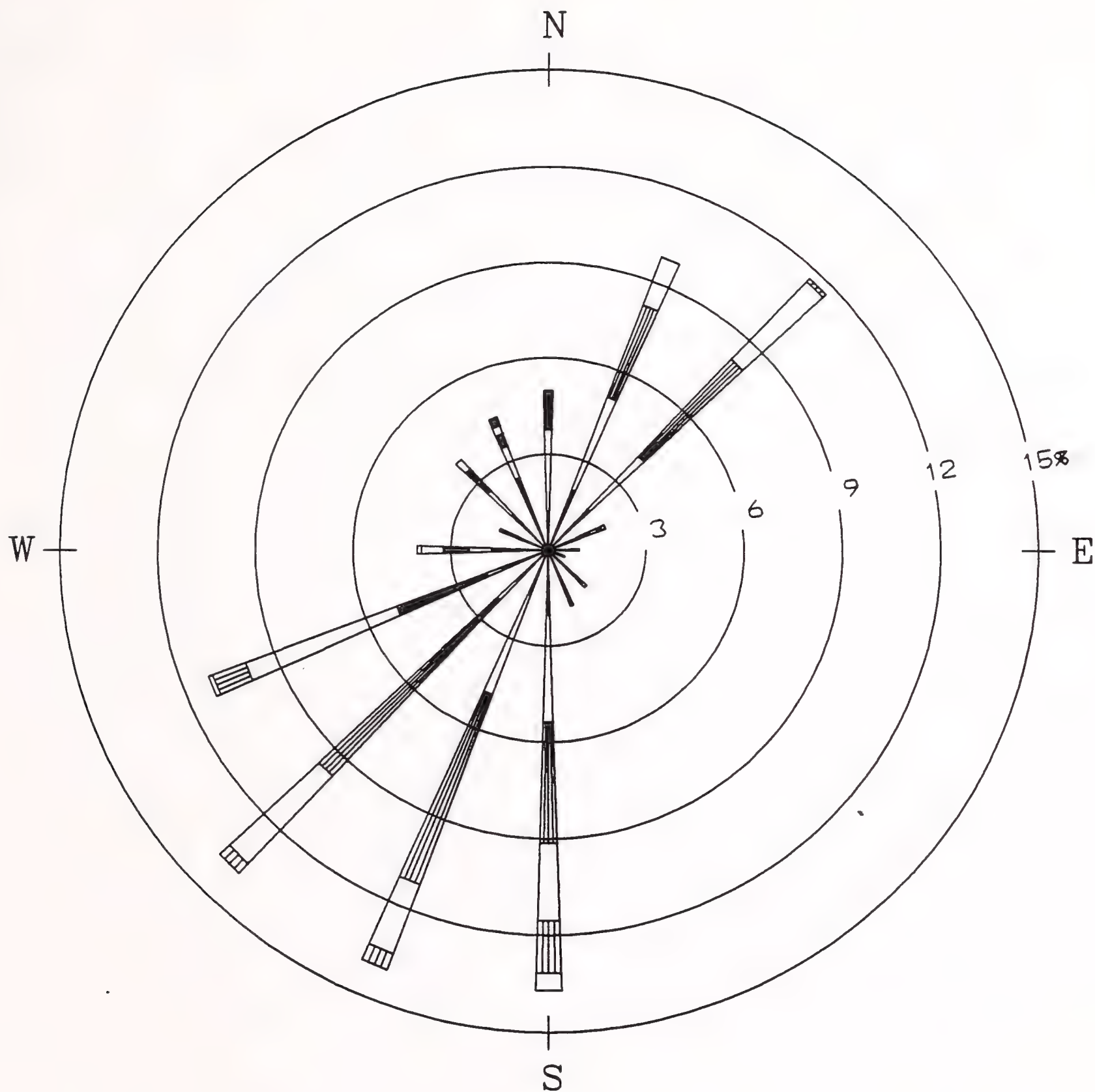
PERIOD: April 1992

Blson  
Engineering

Figure 3.0







Wind Speed Class Boundaries  
(Miles/Hour)

NOTES:  
Diagram of the Frequency of  
Occurrence for each Wind Direction.  
Wind Direction is the Direction  
From Which the Wind is Blowing.

## WINDROSE

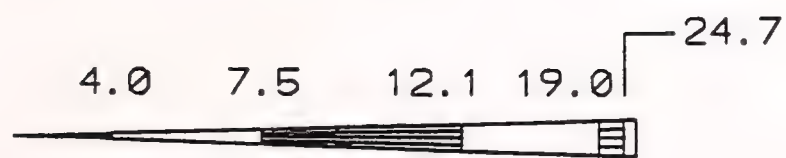
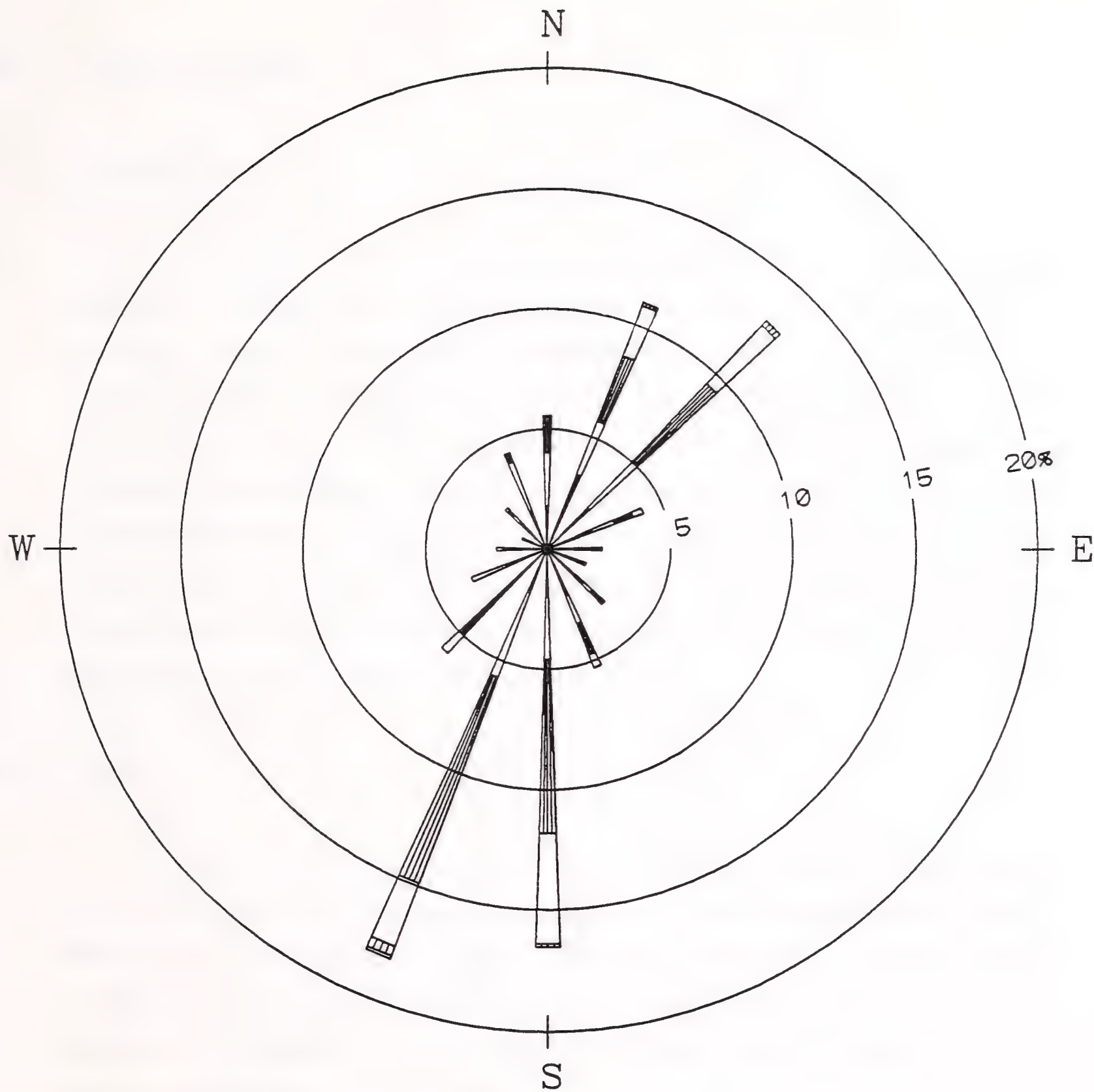
Livingston, MT  
PERIOD: May 1992

Blson  
Engineering

Figure 4.0







Wind Speed Class Boundaries  
(Miles/Hour)

NOTES:

Diagram of the Frequency of  
Occurrence for each Wind Direction.  
Wind Direction is the Direction  
From Which the Wind is Blowing.

# WINDROSE

Livingston, MT

PERIOD: June 1992

Blson  
Engineering

Figure 5.0





## **4.0 DATA ANALYSIS**

### **4.1 Introduction**

The purpose of the ambient air monitoring network is to assess the impacts of existing site contamination and remedial activities on ambient air quality. However, the ambient air monitoring network cannot distinguish between sources associated with previous site contamination and sources associated with current industrial operations. The first step of assessment is to measure parameters which could be reasonably expected to enter the ambient atmosphere. The second step of the assessment is to compare these results with previously established ambient air quality standards. The final step of assessment is to compare the results with background results. The following is a discussion of PM10 results.

### **4.2 PM10**

Section 3.0 of this report provided a comparison between the collected PM10 values and the Montana and national ambient air quality standards. The results indicate values well below these standards. All information collected to-date indicates that the standards will not be exceeded. Envirocon compared the upwind and downwind PM10 data, and the results of this investigation are provided on Table 4.0.



**Table 4.0**  
**Upwind/Downwind PM10 Comparison**

<b>SAMPLE DATE</b>	<b>UPWIND</b>	<b>DOWNWIND</b>	<b>DIFFERENCE</b>
4/6/92	18	16	2
4/12/92	20	16	4
4/18/92	13	13	0
4/24/92	N/A	20	N/A
4/30/92	27	26	1
5/6/92	33	39	-6
5/12/92	36	N/A	N/A
5/18/92	23	23	0
5/24/92	21	18	3
5/30/92	16	19	-3
6/5/92	16	14	2
6/11/92	23	N/A	N/A
6/17/92	9	N/A	N/A
6/23/92	27	29	-2
6/29/92	17	12	5

Units: Micrograms/cubic meter





Two statistical tests were applied to the data. The tests (paired-difference and unpaired t-tests) were designed to assess whether or not there is enough evidence to reject the null hypothesis that the two means are the same. Statistics used to calculate t-test values are summarized on Table 5.0.

**Table 5.0**  
**Summary Statistics**

UPWIND	Mean: Std Dev: No. of Samples:	21.36 7.23 14
DOWNWIND	Mean: Std Dev: No. of Samples:	20.42 7.48 12
DIFFERENCE	Mean: Std Dev: No. of Samples:	0.55 3.09 11

### Comparison of Upwind and Downwind Means

Paired Difference t-test:

$$t = \text{Mean} / (S / (n)^{.5}) \quad \text{where } S = \text{std. dev.}$$

$$t = 0.59$$

$$\text{Critical } t (95\%) = \pm 2.23$$

Unpaired t-test:

$$t = (\text{mean1} - \text{mean2}) / (S * (1/n_1 + 1/n_2)^{.5}) \quad \text{where } S = \text{pooled std. dev.}$$

$$t = 0.32$$

$$\text{Critical } t (95\%) = \pm 2.06$$





The t value for both the paired-difference and unpaired t-tests falls within its respective 95-percent two-tailed confidence interval (as defined by the critical t value). It is concluded that not enough evidence is present to reject the null hypothesis. Therefore, it appears that there is no difference in the mean PM10 values between the upwind and downwind monitoring sites.



## **APPENDIX A**





# Bison Engineering Inc.

Helena, Montana

## 1992 PM10 Particulate Summary

UPWIND

Envirocon, Site #1

Livingston, MT

(Values are in Micrograms per Cubic Meter)

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	-	-	13	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	-	-	-
4	11	-	-	-	-	-	-	-	-	-	-	-
5	-	-	-	-	-	16	-	-	-	-	-	-
6	-	25	-	18	33	-	-	-	-	-	-	-
7	-	-	14	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-	-	-
11	-	-	-	-	-	23	-	-	-	-	-	-
12	-	15	-	20	36	-	-	-	-	-	-	-
13	5	-	29	-	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-	-	-	-
16	-	-	-	-	-	-	-	-	-	-	-	-
17	-	-	-	-	-	9	-	-	-	-	-	-
18	-	11	-	13	23	-	-	-	-	-	-	-
19	10	-	13	-	-	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-	-	-	-	-	-
21	-	-	-	-	-	-	-	-	-	-	-	-
22	-	-	-	-	-	-	-	-	-	-	-	-
23	-	-	-	-	-	27	-	-	-	-	-	-
24	-	-	-	-	21	-	-	-	-	-	-	-
25	13	-	26	-	-	-	-	-	-	-	-	-
26	-	-	-	-	-	-	-	-	-	-	-	-
27	-	-	-	-	-	-	-	-	-	-	-	-
28	-	-	-	-	-	-	-	-	-	-	-	-
29	-	-	-	-	-	17	-	-	-	-	-	-
30	-	-	-	27	16	-	-	-	-	-	-	-
31	14	-	21	-	-	-	-	-	-	-	-	-
No.	5	3	6	4	5	5	0	0	0	0	0	0
Max	14	25	29	27	36	27	0	0	0	0	0	0
Avg	11	17	19	20	26	18	0	0	0	0	0	0

Min: 5    Max: 36    2nd Max: 29    # > 150: 0    Total Obs: 28

Arithmetic Mean: 19    Standard Deviation: 8





# Bison Engineering Inc.

Helena, Montana

## 1992 PM10 Particulate Summary

DOWNWIND

Envirocon, Site #2

Livingston, MT

(Values are in Micrograms per Cubic Meter)

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	-	-	14	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	-	-	-
4	11	-	-	-	-	-	-	-	-	-	-	-
5	-	-	-	-	-	14	-	-	-	-	-	-
6	-	32	-	16	39	-	-	-	-	-	-	-
7	-	-	11	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-	-	-	-	-
12	-	15	-	16	-	-	-	-	-	-	-	-
13	16	-	24	-	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-	-	-	-
16	-	-	-	-	-	-	-	-	-	-	-	-
17	-	-	-	-	-	-	-	-	-	-	-	-
18	-	10	-	13	23	-	-	-	-	-	-	-
19	7	-	14	-	-	-	-	-	-	-	-	-
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21	-	-	-	-	-	-	-	-	-	-	-	-
22	-	-	-	-	-	-	-	-	-	-	-	-
23	-	-	-	-	-	29	-	-	-	-	-	-
24	-	14	-	20	18	-	-	-	-	-	-	-
25	10	-	33	-	-	-	-	-	-	-	-	-
26	-	-	-	-	-	-	-	-	-	-	-	-
27	-	-	-	-	-	-	-	-	-	-	-	-
28	-	-	-	-	-	-	-	-	-	-	-	-
29	-	-	-	-	-	12	-	-	-	-	-	-
30	-	-	-	26	19	-	-	-	-	-	-	-
31	12	-	17	-	-	-	-	-	-	-	-	-
No.	5	4	6	5	4	3	0	0	0	0	0	0
Max	16	32	33	26	39	29	0	0	0	0	0	0
Avg	11	18	19	18	25	18	0	0	0	0	0	0

Min: 7    Max: 39    2nd Max: 33    # > 150: 0    Total Obs: 27

Arithmetic Mean: 18    Standard Deviation: 8



BISON ENGINEERING INC.  
HELENA, MONTANA

Envirocon, Site #1

Livingston, MT

April 1992

\* \* \* \* \* WIND SPEED - MPH \* \* \* \*

DAY	HOUR																								AVG.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
1	4	4	3	5	4	4	3	9	12	8	9	6	8	7	7	6	5	6	5	5	6	4	5	6	6
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30	10	8	10	9	7	4	5	4	2	12	15	26	23	24	24	27	27	24	16	10	5	4	10	12	13
AVG.	7	7	7	8	8	8	8	8	9	10	11	11	11	12	13	12	13	12	9	7	8	7	7	7	7

Valid Hrs: 720    Completeness: 100.0%





BISON ENGINEERING INC.  
HELENA, MONTANA

Envirocon, Site #1

Livingston, MT

May 1992

\* \* \* \* \* WIND SPEED - MPH \* \* \* \*

DAY	HOUR																								AVG.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
1	10	11	15	9	10	14	18	21	22	20	19	21	20	19	17	17	15	13	10	7	8	6	8	5	14
2	9	11	11	9	11	10	10	13	13	13	12	12	18	18	19	17	15	12	6	5	5	6	6	6	11
3	6	4	5	4	5	7	6	4	9	10	16	17	16	15	15	11	8	9	4	3	7	2	3	3	8
4	4	4	4	3	3	4	4	6	11	11	9	9	11	13	13	14	12	10	6	6	8	5	4	3	7
5	3	4	5	4	4	3	5	7	8	9	7	4	5	6	6	7	11	12	9	7	3	4	6	7	6
6	5	5	3	5	6	14	15	14	15	12	11	7	6	10	10	6	7	8	6	5	5	6	5	5	8
7	5	3	3	3	4	10	12	14	13	11	16	16	15	16	12	8	10	8	8	6	4	6	9	5	9
8	2	3	5	5	15	14	11	10	8	12	17	25	23	16	4	9	16	13	14	15	19	11	11	13	12
9	13	8	6	4	12	16	13	12	15	14	14	14	13	12	6	4	5	9	5	4	2	6	9	8	9
10	15	11	11	13	15	16	20	20	25	25	24	20	21	21	22	24	22	25	24	15	6	5	3	3	17
11	3	8	5	4	6	3	3	6	5	10	12	19	21	21	22	26	20	13	17	16	10	5	5	5	11
12	6	9	7	3	3	2	2	3	4	6	7	9	12	14	15	15	15	14	12	11	8	6	6	4	8
13	3	2	2	4	3	3	3	6	5	4	3	6	8	14	18	17	18	11	8	9	6	9	11	10	8
14	11	12	12	11	11	11	12	12	16	16	15	13	17	18	14	15	13	11	6	6	4	3	3	4	11
15	6	6	10	7	10	15	16	17	13	13	12	11	12	18	16	16	21	12	20	16	15	7	9	10	13
16	7	12	6	4	10	8	5	3	4	8	12	18	18	13	8	7	7	4	2	3	5	4	3	3	7
17	3	3	4	4	5	7	10	12	7	11	10	12	10	6	9	7	5	5	18	12	10	18	14	18	9
18	15	13	18	12	9	8	13	11	12	10	11	15	13	12	16	13	11	12	6	3	3	4	3	3	10
19	3	3	3	1	1	1	3	4	8	7	9	10	11	7	13	11	6	6	5	6	8	7	8	8	6
20	9	6	7	9	6	4	6	11	20	21	25	22	20	20	19	17	11	12	5	4	4	4	7	8	12
21	7	8	8	7	9	9	11	12	13	15	17	18	18	17	19	17	18	16	15	14	13	11	11	12	13
22	11	11	10	9	8	9	10	10	8	9	10	12	12	11	11	12	13	13	12	7	5	4	5	3	9
23	4	2	4	6	3	4	5	3	4	5	5	5	6	8	8	7	10	10	8	5	6	6	4	2	5
24	3	3	1	3	2	2	2	7	11	16	19	18	16	16	16	17	19	19	21	17	15	16	14	8	12
25	4	6	6	8	6	8	9	8	7	6	8	10	11	13	13	13	13	12	11	8	5	3	5	4	8
26	3	4	4	2	4	4	7	6	16	10	8	7	7	8	7	5	8	6	3	5	3	7	13	12	7
27	9	9	9	8	5	3	3	3	6	9	8	6	5	7	7	5	5	3	4	5	4	4	7	5	6
28	7	8	11	10	9	10	10	11	7	4	6	12	10	9	8	6	6	6	6	6	8	13	7	8	8
29	3	2	3	2	3	3	3	9	11	16	19	19	8	13	14	11	9	10	8	7	6	4	3	3	8
30	6	9	9	9	8	8	9	10	10	10	12	12	8	6	12	13	20	20	9	6	11	10	9	10	10
31	9	9	11	11	8	8	8	5	11	12	9	8	6	7	8	7	7	7	6	5	6	3	2	6	7
AVG.	7	7	7	6	7	8	9	9	11	11	12	13	13	13	13	12	12	11	9	8	7	7	7	7	7

Valid Hrs: 744    Completeness: 100.0%



BISON ENGINEERING INC.  
HELENA, MONTANA

Envirocon, Site #1

Livingston, MT

June 1992

\* \* \* \* \* WIND SPEED - MPH \* \* \* \* \*

DAY	HOUR																								AVG.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
1	4	3	4	5	4	5	11	15	14	12	9	5	6	5	5	7	8	9	6	7	6	6	3	2	7
2	4	3	5	10	12	10	10	12	11	9	10	10	6	5	7	8	15	16	15	12	10	9	13	9	10
3	9	9	8	5	11	11	11	12	16	16	17	19	19	18	19	17	15	12	10	6	3	3	5	5	12
4	5	8	3	4	1	2	2	8	11	14	14	13	14	14	13	12	11	8	10	8	9	9	8	5	9
5	2	5	4	3	5	5	3	5	6	5	6	6	10	6	6	11	6	4	5	9	4	5	2	3	5
6	5	5	3	2	3	3	2	3	4	4	5	5	6	6	6	9	12	16	13	8	6	5	7	6	6
7	5	3	3	2	3	4	5	10	10	6	4	5	7	6	6	8	7	11	6	4	6	5	7	2	6
8	4	5	2	4	4	4	4	6	8	4	5	4	5	7	12	12	8	5	9	7	4	3	2	3	5
9	3	5	3	4	5	7	6	6	11	12	8	11	11	16	15	12	9	9	11	8	4	3	4	8	8
10	8	8	5	5	12	12	13	11	8	7	8	6	6	7	6	7	6	6	4	11	19	17	15	13	9
11	7	12	13	10	10	9	8	10	11	8	4	7	10	12	11	12	8	3	8	11	5	8	8	7	9
12	7	8	7	4	2	9	6	6	6	5	6	13	14	16	13	13	15	16	14	14	14	10	6	11	10
13	13	15	10	19	10	15	13	18	21	24	25	22	19	19	21	17	15	13	10	7	5	5	4	6	14
14	4	4	2	8	5	6	8	9	11	12	21	22	16	9	13	16	11	6	3	6	7	7	8	11	9
15	13	14	11	10	7	10	12	11	14	11	9	6	3	3	9	11	8	2	2	5	7	8	10	10	9
16	9	8	9	12	11	13	14	16	15	16	18	17	17	14	17	14	13	8	8	9	6	11	13	15	13
17	15	12	8	12	12	12	13	15	16	15	14	14	10	11	12	12	10	12	10	6	9	15	9	3	12
18	7	9	9	9	9	10	11	11	8	4	5	6	6	5	5	6	7	9	13	11	12	11	11	6	8
19	6	2	4	3	2	2	1	4	4	4	6	10	11	12	14	13	9	6	9	6	3	5	2	2	6
20	2	3	2	3	4	9	13	13	11	9	5	4	5	5	5	6	5	4	2	6	6	9	6	8	6
21	8	6	10	10	11	6	10	12	11	8	8	7	9	9	5	8	4	4	11	10	9	7	2	3	8
22	5	7	3	3	2	2	6	10	9	10	9	5	5	5	6	11	7	6	3	4	7	5	2	2	6
23	3	1	4	3	3	2	2	4	9	8	4	10	15	14	13	13	9	5	5	3	5	6	5	4	6
24	5	3	10	8	13	11	12	9	9	14	11	12	14	14	15	16	10	6	10	10	9	10	11	10	11
25	10	10	7	7	6	6	7	10	9	9	10	13	15	15	14	12	12	14	12	8	4	5	3	5	9
26	7	6	6	6	4	3	5	4	5	3	4	4	6	7	6	11	15	14	11	11	11	12	9	11	8
27	12	12	13	12	11	13	14	15	14	12	12	11	13	10	7	9	9	6	5	5	4	4	3	3	10
28	4	5	4	4	3	4	5	2	4	5	7	8	9	12	14	17	19	20	15	16	8	9	13	14	9
29	10	11	12	9	12	17	13	13	13	14	12	12	15	16	10	7	4	3	3	3	4	4	5	6	10
30	7	7	7	4	5	2	6	7	4	4	5	3	3	7	4	4	9	10	12	6	2	2	2	4	5
AVG.	7	7	6	7	7	7	8	10	10	9	9	10	10	10	10	11	10	9	9	8	7	7	7	7	7

Valid Hrs: 720    Completeness: 100.0%





BISON ENGINEERING INC.  
HELENA, MONTANA

Envirocon, Site #1

Livingston, MT

April 1992

\* \* \* \* \* TEMPERATURE - DEG C \* \* \* \*

DAY	HOUR																								AVG.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
1	-0.9	-1.7	-1.1	0.4	-2.4	-2.1	0.9	6.0	7.8	9.9	12.4	14.7	15.0	16.2	16.2	16.2	16.6	16.2	14.6	12.1	9.4	7.4	6.1	5.2	8.1
2	3.1	3.2	4.8	5.4	5.8	5.2	6.9	8.4	10.2	11.9	14.4	16.4	18.0	18.6	19.6	19.8	20.1	19.8	17.4	13.6	12.5	11.7	12.9	12.3	12.2
3	12.0	11.4	11.6	11.0	10.9	10.0	10.4	11.4	12.7	14.7	16.9	19.6	21.6	22.3	22.5	22.6	22.4	20.7	19.1	17.8	16.6	15.6	15.2	12.7	15.9
4	10.8	8.9	7.2	5.6	3.7	3.4	3.8	6.6	9.4	11.1	12.9	14.0	11.9	12.4	14.1	13.6	10.9	11.4	10.8	10.8	9.4	9.6	7.4	4.8	9.4
5	4.3	4.8	4.2	1.1	0.0	-0.5	-0.8	0.0	1.4	3.1	4.5	4.7	5.1	6.8	7.2	6.0	5.0	4.1	2.9	1.1	0.5	0.0	-0.3	-0.2	2.7
6	0.2	0.0	-1.6	-2.2	-2.0	-1.7	-1.0	-0.2	0.9	3.8	4.3	4.4	3.7	3.6	4.6	2.0	2.4	0.6	0.2	0.3	1.1	-0.4	-1.2	-1.1	0.9
7	-0.6	-1.4	-1.8	-1.6	-3.3	-4.1	-3.9	-2.1	-0.1	2.0	3.5	4.8	5.2	6.3	6.8	7.3	6.8	5.5	3.4	2.3	0.7	-0.2	-0.5	-0.7	1.4
8	-0.7	-0.7	-0.8	-0.9	-1.0	-0.9	-0.8	0.4	1.3	2.6	2.8	3.0	3.2	4.7	6.0	6.5	6.5	6.0	5.1	3.3	3.0	3.0	2.9	2.3	2.4
9	1.7	0.7	0.4	-0.1	-0.4	-0.5	-0.1	0.1	-0.1	0.0	0.9	1.5	1.8	2.3	2.7	3.3	5.3	9.6	9.4	8.0	5.4	3.5	3.4	3.7	2.6
10	4.2	4.2	4.0	3.9	4.7	4.8	5.1	5.6	6.5	8.7	9.1	7.3	6.3	8.6	5.8	3.8	3.1	2.4	2.1	1.1	0.5	0.5	0.8	1.0	4.3
11	2.0	2.2	1.8	1.5	0.4	-0.7	-1.2	-2.5	-3.7	-3.8	-3.8	-3.9	-4.4	-4.5	-4.5	-4.6	-4.7	-4.7	-5.1	-5.3	-5.6	-5.8	-5.9	-5.9	-3.0
12	-6.0	-5.9	-5.7	-5.7	-5.7	-5.8	-5.3	-3.5	-2.9	-1.3	-0.3	2.1	5.1	7.3	9.3	9.9	9.5	8.7	8.4	7.7	7.2	6.6	5.5	4.6	1.8
13	3.7	3.2	2.5	1.6	1.6	1.0	1.8	5.0	7.1	9.9	12.3	15.0	17.2	19.4	18.6	18.5	17.5	16.2	14.8	12.5	11.2	11.7	10.3	8.7	10.1
14	7.5	6.8	6.7	4.9	3.8	4.4	4.3	6.8	10.1	12.5	14.0	14.5	14.9	15.3	15.5	16.0	15.8	15.8	14.7	12.5	11.1	10.4	9.9	8.6	10.7
15	8.6	8.3	8.5	7.7	7.1	6.1	5.9	5.5	6.3	7.8	8.3	9.3	9.5	9.1	9.7	9.9	10.4	10.5	9.5	8.1	7.1	6.1	4.5	3.8	7.8
16	3.3	2.8	3.4	4.1	4.0	3.7	4.2	6.5	7.5	8.8	10.3	11.8	13.3	14.5	13.2	13.1	15.1	15.3	15.0	13.6	12.8	12.2	12.6	13.1	9.8
17	13.0	13.7	13.5	13.6	13.1	12.9	12.9	12.8	12.7	13.4	10.1	8.0	3.6	4.2	5.9	7.6	8.5	8.4	7.8	7.1	6.9	6.5	6.0	4.0	9.4
18	2.9	2.8	3.0	2.9	3.0	2.7	2.7	2.7	2.9	3.2	3.8	4.6	4.6	5.0	5.6	7.8	8.7	8.3	7.2	6.2	5.8	5.7	4.8	4.9	4.7
19	4.5	4.2	4.1	3.9	3.5	3.5	3.7	3.5	3.3	3.8	4.3	4.5	4.8	4.0	3.9	3.8	4.0	4.2	4.6	3.7	2.6	1.8	1.5	2.1	3.7
20	2.7	2.9	2.7	2.0	1.8	2.5	3.6	4.7	6.0	8.0	9.7	11.8	13.1	13.7	14.3	14.9	15.4	15.4	14.4	11.1	9.0	8.4	8.5	8.0	8.5
21	7.1	6.7	6.3	5.8	5.2	3.3	4.0	6.6	10.5	12.6	14.9	16.2	16.7	15.4	16.3	15.2	15.9	14.3	13.0	10.0	9.0	8.2	7.8	7.3	10.3
22	6.7	6.5	5.9	5.4	5.0	5.1	4.9	5.6	6.7	8.4	7.7	9.0	11.6	11.7	10.7	8.1	5.4	5.0	3.2	1.7	0.7	1.3	1.9	1.5	5.8
23	1.1	0.8	1.2	1.6	1.1	0.9	0.7	1.2	2.0	3.0	3.7	4.4	5.3	5.6	6.0	6.3	6.4	6.0	4.4	4.4	3.6	3.2	3.1	1.8	3.2
24	0.9	1.4	0.6	0.5	0.2	0.1	1.0	2.6	4.4	5.6	6.8	7.5	8.8	10.2	10.2	10.5	10.0	9.8	8.9	6.5	4.8	2.3	0.5	-0.1	4.8
25	-0.2	-1.4	-1.7	-2.5	-2.6	-2.5	-0.2	1.7	4.3	7.3	10.7	12.1	13.8	14.5	15.6	16.0	16.1	16.1	14.8	12.2	9.7	7.6	7.2	5.9	7.3
26	5.1	3.4	2.6	1.7	1.0	0.6	2.4	5.1	9.5	14.1	17.2	20.2	22.0	23.9	24.3	24.8	24.3	24.0	20.5	17.8	14.8	12.7	11.8	11.1	13.1
27	10.0	9.7	9.1	10.9	12.1	11.9	13.7	16.6	18.4	20.6	22.0	22.6	22.7	23.5	23.5	23.5	23.2	22.1	20.4	18.8	17.8	16.2	12.7	12.4	17.3
28	13.2	12.5	12.6	11.8	10.7	9.1	10.1	13.1	14.7	16.9	18.6	19.7	20.2	20.7	21.3	21.2	21.2	21.4	20.4	18.0	14.4	13.6	12.6	11.2	15.8
29	9.9	9.6	8.9	9.0	10.9	11.1	12.8	14.5	16.4	19.1	22.8	24.5	25.7	26.8	27.1	27.4	27.2	27.0	26.1	24.3	23.7	23.8	23.2	22.1	19.7
30	20.9	20.4	19.8	17.2	15.9	14.9	15.3	16.2	16.0	17.0	18.8	19.6	18.1	17.9	18.9	19.1	18.9	18.6	16.6	12.2	11.9	11.3	10.2	9.6	16.5
AVG.	5.0	4.7	4.4	4.0	3.6	3.3	3.9	5.4	6.7	8.5	9.8	10.8	11.3	12.0	12.4	12.3	12.3	12.0	10.8	9.1	7.9	7.2	6.5	5.8	

Valid Hrs: 720 Completeness: 100.0%

Minimum: -6.0 Maximum: 27.4 Mean: 7.9





BISON ENGINEERING INC.  
HELENA, MONTANA

Envirocon, Site #1

Livingston, MT

May 1992

\* \* \* \* \* TEMPERATURE - DEG C \* \* \* \*

DAY	HOUR																								AVG.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
1	8.9	8.5	8.4	7.6	6.8	6.3	6.5	6.9	7.3	7.9	8.8	9.8	11.1	12.2	13.0	13.7	14.1	14.2	13.3	11.6	10.1	6.7	6.3	6.2	9.4
2	6.2	5.9	4.9	4.9	4.3	4.8	6.6	8.1	10.1	12.5	14.9	17.3	18.3	19.2	19.7	20.0	20.2	19.9	19.1	15.7	14.5	12.1	9.6	8.6	12.4
3	7.9	6.6	5.9	5.8	6.0	5.9	7.9	9.8	13.3	15.3	16.8	17.7	18.8	20.0	20.6	21.0	21.4	20.9	19.9	16.3	13.3	10.1	8.3	7.3	13.2
4	7.0	4.9	4.1	2.7	2.7	4.4	6.3	11.8	14.0	16.4	19.2	21.3	22.2	22.7	23.0	23.4	23.3	22.6	21.2	17.3	14.1	11.8	9.1	7.3	13.9
5	5.9	4.8	4.3	3.4	3.5	4.0	6.1	11.4	15.4	17.4	20.3	23.8	24.8	25.7	26.4	26.1	25.5	24.8	23.0	19.4	15.9	13.9	12.5	12.6	15.5
6	10.7	7.8	7.1	8.6	9.0	11.1	13.4	15.6	17.7	20.2	22.6	25.9	28.5	28.6	28.6	29.2	28.7	28.0	26.3	22.5	21.1	18.3	16.3	15.3	19.2
7	12.6	10.9	10.7	9.7	9.1	14.0	16.5	17.9	19.7	21.9	23.6	24.8	25.2	25.8	26.2	26.6	25.8	25.4	23.0	21.3	20.9	18.8	15.3	13.2	19.1
8	12.1	9.9	8.7	8.7	15.8	16.5	17.9	19.0	20.7	21.5	19.9	15.0	14.6	13.0	11.0	12.1	14.6	14.6	14.3	14.2	13.2	13.2	12.3	11.9	14.4
9	10.7	8.5	7.0	5.6	4.6	3.3	3.2	4.1	4.6	4.8	5.4	5.7	6.8	7.6	6.0	8.0	9.9	8.2	7.4	6.0	5.3	4.4	4.5	5.2	6.1
10	6.5	5.7	4.8	4.8	6.0	6.6	8.0	8.8	10.7	11.6	12.2	13.6	14.6	15.0	16.2	17.6	17.6	17.4	16.8	16.1	13.0	11.4	10.2	8.9	11.4
11	9.3	9.6	8.0	7.2	6.4	6.0	6.6	6.7	7.5	8.3	10.6	12.2	13.3	14.3	14.2	14.0	14.0	12.3	10.2	8.8	7.3	6.0	6.4	5.6	9.4
12	4.1	3.0	2.2	1.6	-0.4	0.2	2.4	4.3	5.6	6.8	7.9	8.6	9.0	9.6	9.7	9.5	9.5	9.5	9.2	8.5	7.7	7.1	7.0	6.2	6.2
13	5.3	4.3	2.7	2.0	1.7	2.5	3.3	4.6	6.1	7.5	9.6	13.6	16.0	17.8	18.2	17.7	16.9	16.5	16.6	15.6	14.1	12.4	13.0	10.4	10.4
14	9.5	9.0	9.0	7.3	6.6	6.9	9.0	11.9	14.9	16.1	17.4	18.6	19.7	20.4	20.9	21.5	21.6	21.6	21.0	18.9	16.7	13.9	10.8	8.6	14.7
15	8.9	9.1	12.8	11.7	12.3	12.9	13.2	14.2	16.3	17.8	19.0	20.0	19.1	17.1	16.4	16.9	14.8	11.3	12.6	12.4	10.3	7.0	4.4	2.9	13.1
16	2.1	1.0	0.3	0.3	1.3	0.4	1.3	3.9	5.5	8.5	10.6	11.7	12.6	14.3	15.6	16.9	17.7	18.8	18.6	15.2	11.3	9.0	7.8	6.1	8.8
17	4.9	4.4	6.2	6.0	5.2	7.6	10.4	12.7	15.4	17.6	20.6	23.0	24.5	25.2	25.6	26.3	26.4	25.8	21.8	19.5	17.9	18.4	18.3	17.0	16.7
18	16.4	15.5	16.4	16.5	16.7	15.5	15.9	17.0	18.8	21.2	24.2	25.7	24.3	25.2	23.8	21.5	21.9	21.2	19.9	17.4	15.3	12.6	11.0	10.1	18.5
19	8.3	7.6	6.8	5.7	5.3	5.6	8.0	11.2	15.3	19.0	22.2	23.8	24.7	26.7	28.6	28.2	27.8	28.1	24.7	21.8	20.7	20.5	20.9	20.3	18.0
20	20.5	18.3	16.6	16.4	14.1	13.7	15.2	18.2	20.0	21.1	21.1	21.5	23.1	23.1	24.1	23.0	20.3	18.7	17.9	17.0	16.4	15.2	13.5	12.3	18.4
21	12.4	12.5	12.4	12.0	9.9	9.1	8.3	7.6	7.7	8.0	8.5	8.1	7.7	7.9	8.0	7.7	7.3	6.9	6.6	6.3	6.1	5.9	5.7	5.4	8.3
22	5.3	4.9	4.8	4.8	4.7	4.7	4.9	5.3	6.0	7.3	8.4	9.2	9.5	10.2	11.0	11.7	12.1	12.1	11.7	10.5	9.1	8.4	8.9	8.9	8.1
23	8.8	7.4	6.9	6.3	5.8	6.3	8.1	9.9	12.0	13.5	15.4	17.6	19.7	20.4	21.0	21.8	21.5	20.3	19.2	17.5	16.3	15.2	13.4	11.5	14.0
24	11.1	9.9	8.7	8.7	7.9	8.7	10.3	12.4	13.1	13.6	14.1	14.8	15.4	16.0	16.6	16.8	16.4	15.2	13.4	11.9	11.2	10.5	10.1	9.2	12.3
25	8.5	7.5	6.6	5.4	4.8	4.8	4.8	5.1	6.1	8.2	10.2	11.9	13.1	14.1	15.2	15.9	16.0	15.6	14.7	13.0	11.0	10.0	8.4	7.3	9.9
26	6.2	5.3	4.6	3.5	3.7	6.2	8.6	11.7	13.7	15.5	16.8	16.1	16.0	17.3	18.6	19.1	17.6	14.9	14.1	13.7	13.0	12.1	10.9	10.3	12.1
27	10.1	10.0	9.6	9.2	8.9	8.7	8.8	9.4	9.8	10.1	10.7	11.3	12.3	11.8	13.6	12.3	12.1	13.0	13.3	11.9	9.9	9.0	8.6	9.1	10.6
28	8.6	8.7	8.4	8.1	7.6	7.9	10.0	11.4	13.2	15.7	16.7	17.6	18.5	19.2	20.2	20.6	20.6	20.3	19.3	16.7	15.1	15.1	13.6	12.1	14.4
29	10.5	9.3	8.8	8.3	8.6	8.3	9.5	12.4	14.6	15.1	14.5	11.4	12.3	13.3	15.2	15.4	15.7	15.5	14.9	12.1	11.8	11.4	10.7	9.8	12.1
30	8.8	8.9	9.1	9.6	9.6	9.9	10.8	11.7	13.1	14.7	16.2	17.4	18.2	19.2	19.5	18.5	13.7	12.3	11.1	10.7	10.2	9.7	9.0	7.7	12.5
31	7.4	7.1	8.2	8.8	8.7	8.2	8.7	9.9	11.2	11.0	11.4	13.2	14.1	14.7	15.2	16.7	17.1	17.1	16.8	14.2	12.2	10.5	8.3	7.3	11.6
AVG.	8.9	8.0	7.6	7.1	7.0	7.5	8.7	10.5	12.2	13.7	15.2	16.2	17.0	17.7	18.1	18.4	18.1	17.5	16.5	14.6	13.1	11.6	10.5	9.5	

Valid Hrs: 744 Completeness: 100.0%

Minimum: -0.4 Maximum: 29.2 Mean: 12.7





BISON ENGINEERING INC.  
HELENA, MONTANA

Envirocon, Site #1

Livingston, MT

June 1992

\* \* \* \* \* TEMPERATURE - DEG C \* \* \* \*

DAY	HOUR																								AVG.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
1	6.9	5.8	4.5	3.8	3.4	4.4	8.7	10.8	12.9	16.0	18.8	20.9	22.4	23.4	24.2	24.4	24.7	23.9	22.2	19.5	16.4	14.2	12.8	10.6	14.8
2	9.6	9.4	8.5	11.3	11.7	12.2	15.2	16.9	18.0	19.1	20.4	21.8	23.4	24.4	23.7	23.5	16.1	15.3	16.3	15.8	15.3	15.2	15.1	14.2	16.4
3	12.5	12.1	11.8	10.2	9.5	10.4	11.8	14.0	15.5	16.6	17.7	18.2	18.7	19.3	19.6	19.9	20.1	19.9	19.2	16.6	12.9	10.1	10.3	7.4	14.8
4	6.7	5.9	4.7	3.3	1.7	3.0	7.6	12.5	14.4	15.5	16.4	17.7	18.6	19.2	19.4	19.5	19.5	18.2	16.7	14.5	12.1	10.0	9.0	8.7	12.3
5	8.4	8.3	8.4	8.3	8.1	7.8	7.5	7.1	7.9	8.3	8.4	10.5	11.2	11.6	13.5	10.0	10.6	11.8	11.6	9.4	8.4	8.1	7.4	7.5	9.2
6	6.7	5.4	4.7	4.5	3.2	3.0	5.2	7.9	9.7	11.7	13.9	15.0	16.6	17.5	18.6	18.2	17.5	16.2	14.3	14.2	13.4	12.0	12.1	10.9	11.4
7	10.5	8.6	6.5	6.0	5.0	5.3	8.6	12.8	14.3	17.2	20.1	21.2	22.2	22.9	23.2	23.2	22.9	20.5	20.7	19.8	17.3	14.5	13.3	11.5	15.3
8	9.6	9.3	7.8	7.4	6.2	7.9	10.1	13.4	17.1	18.9	21.5	23.4	24.5	24.4	22.7	23.0	23.2	23.3	22.1	19.7	16.6	14.2	12.1	11.2	16.2
9	9.5	9.1	8.4	7.8	6.8	8.6	10.8	16.5	18.9	21.6	23.0	25.0	25.7	24.0	24.5	25.4	26.8	26.4	22.7	20.8	19.6	16.1	16.5	17.7	18.0
10	15.0	14.2	13.0	12.1	15.5	16.8	17.7	19.1	22.1	24.8	27.0	28.5	29.8	28.7	27.1	27.6	29.1	28.1	26.5	24.9	23.6	22.9	22.4	21.5	22.4
11	20.8	19.2	18.7	17.0	17.1	17.4	17.5	19.3	19.5	21.5	25.3	26.1	25.8	21.9	18.0	17.7	17.5	17.9	18.7	18.1	18.3	17.9	15.9	19.4	19.9
12	15.0	13.0	12.6	12.6	11.9	13.8	14.8	16.4	17.9	20.3	22.3	23.8	24.6	26.0	25.6	26.4	27.0	26.2	24.7	23.0	21.9	19.7	19.1	18.4	19.9
13	16.6	14.6	12.9	12.3	11.2	12.0	12.1	12.9	14.3	14.8	15.4	15.9	15.9	16.3	16.5	17.4	18.1	18.3	17.7	16.3	14.4	13.7	12.7	11.5	14.7
14	10.7	10.3	9.5	9.6	8.8	8.8	9.6	10.4	10.2	10.7	12.5	13.0	12.9	10.8	11.9	11.8	11.4	11.4	11.2	11.0	10.6	10.6	10.2	9.9	10.7
15	9.5	9.2	9.2	9.3	9.5	9.4	9.1	8.8	9.2	9.2	9.4	9.7	9.8	10.0	10.9	10.6	10.5	10.2	9.6	9.6	8.7	8.2	7.6	7.3	9.4
16	7.7	7.5	7.4	7.3	7.0	6.7	6.3	5.9	5.6	5.3	5.4	5.6	5.3	5.9	6.5	7.1	7.7	7.6	8.0	8.3	8.1	8.1	8.1	8.3	6.9
17	8.8	9.1	9.3	9.7	9.5	9.8	11.0	12.1	12.4	12.5	12.7	13.9	15.4	16.5	17.8	18.5	19.3	19.6	19.1	17.5	16.2	15.6	14.6	14.1	14.0
18	13.7	13.4	13.3	13.1	12.4	12.3	13.6	14.8	16.4	19.1	20.2	21.3	21.8	23.3	23.1	23.4	23.3	23.0	21.6	19.8	17.6	16.5	16.0	14.2	17.8
19	13.4	11.9	10.6	9.9	8.8	10.2	14.2	15.6	17.4	18.5	19.5	20.4	21.6	22.4	23.1	23.5	23.1	22.1	20.1	19.0	17.4	17.7	15.4	13.4	17.1
20	12.2	10.9	9.9	9.9	9.1	11.1	13.7	15.5	17.7	20.3	23.0	24.9	25.9	26.7	26.6	26.3	26.9	26.7	26.2	24.3	20.9	18.7	18.0	17.9	19.3
21	17.2	16.3	15.7	16.1	16.2	16.6	17.6	18.7	20.8	22.9	24.7	26.4	27.3	27.4	28.7	28.1	26.5	26.0	25.0	22.9	20.5	19.0	17.8	16.1	21.4
22	15.6	14.9	13.7	13.2	12.0	13.2	15.1	19.0	20.6	22.5	24.3	26.7	27.7	28.4	29.1	29.5	28.5	28.4	28.0	25.6	22.9	20.4	17.8	16.9	21.4
23	15.5	14.5	14.6	13.1	12.1	12.8	16.1	19.3	21.9	24.0	27.0	28.4	29.1	29.6	30.3	30.8	30.9	30.8	30.3	27.7	23.1	21.0	19.5	17.5	22.5
24	17.7	15.4	16.0	15.7	14.4	14.0	15.3	16.9	18.1	19.5	20.5	21.8	22.7	23.3	24.1	24.3	22.7	22.3	20.6	20.4	19.5	18.7	18.3	17.5	19.2
25	16.3	15.6	14.4	13.6	12.6	13.0	14.7	15.8	17.1	18.5	19.6	20.6	21.4	22.2	22.5	22.2	21.0	20.3	19.5	18.6	17.8	16.8	15.7	15.1	17.7
26	14.1	14.4	13.5	12.5	11.0	11.1	13.3	16.1	18.6	21.5	23.1	24.9	25.1	25.1	25.3	25.1	23.9	22.7	21.8	21.1	20.2	19.4	18.6	18.1	19.2
27	17.5	17.2	16.7	16.2	15.7	16.0	16.6	17.7	19.4	21.9	23.4	25.0	25.9	25.3	25.5	25.0	22.8	19.1	18.3	17.8	17.7	16.8	15.8	15.3	19.5
28	15.4	15.5	15.1	15.0	14.5	14.6	15.4	17.0	19.0	19.9	20.9	21.9	22.8	23.3	23.8	23.6	22.9	21.2	18.8	15.9	13.1	14.1	14.1	13.6	18.0
29	13.2	12.4	12.0	12.1	11.8	11.4	11.2	11.5	11.7	11.7	12.3	13.1	13.3	13.7	14.2	14.4	13.6	14.1	14.0	13.5	13.1	13.1	12.7	12.7	12.8
30	12.6	12.1	12.0	12.2	11.7	11.6	11.1	10.2	10.1	10.3	9.7	10.0	11.1	12.5	12.9	11.7	12.0	11.4	10.9	11.1	10.6	10.4	10.1	10.2	11.2
AVG.	12.6	11.9	11.2	10.8	10.3	10.8	12.4	14.2	15.6	17.2	18.6	19.9	20.6	20.9	21.1	21.1	20.7	20.1	19.2	17.9	16.3	15.1	14.4	13.5	

Valid Hrs: 720 Completeness: 100.0%

Minimum: 1.7 Maximum: 30.9 Mean: 16.1





BISON ENGINEERING INC.  
HELENA, MONTANA

Envirocon, Site #1

Livingston, MT

April 1992

\* \* \* \* \* WIND DIRECTION \* \* \* \*

DAY	HOUR																								AVG.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
1	355	27	65	118	46	52	24	214	212	220	216	230	215	230	288	261	265	278	338	229	204	237	215	212	243
2	73	101	206	234	218	225	228	205	216	210	210	210	246	261	262	252	250	243	236	207	243	214	228	241	226
3	236	234	227	232	225	230	218	215	213	218	205	192	216	254	274	260	219	208	247	244	243	262	238	260	232
4	128	41	13	8	24	329	278	252	61	15	354	74	257	315	274	117	286	200	358	283	78	244	319	22	343
5	52	310	29	349	329	352	15	178	235	236	236	230	214	269	258	247	250	337	346	331	103	266	215	219	280
6	246	218	347	261	241	253	225	213	201	209	247	273	267	261	267	305	255	258	256	211	231	284	239	254	249
7	248	252	267	282	261	248	240	229	224	240	265	258	286	284	285	289	276	281	291	10	52	94	30	37	275
8	60	165	202	216	242	174	157	290	331	138	111	103	74	6	53	263	251	252	327	4	44	48	36	55	66
9	60	43	50	47	27	26	36	41	49	55	68	43	66	65	28	46	9	214	213	270	25	16	0	360	36
10	272	258	240	238	244	244	252	241	247	281	306	48	76	74	71	75	69	69	60	278	1	49	245	42	310
11	199	349	333	351	58	56	60	61	62	63	66	68	67	72	71	68	63	60	61	69	71	64	63	65	58
12	65	68	51	41	25	40	24	34	54	343	257	241	56	86	32	352	38	7	46	8	204	238	218	188	32
13	13	235	24	15	228	353	197	113	52	39	43	59	47	36	264	269	266	264	80	11	272	289	72	66	9
14	46	231	219	226	199	183	321	186	272	92	85	54	0	44	63	74	65	60	51	37	20	18	14	353	45
15	11	10	345	14	291	10	0	51	18	23	40	66	59	65	65	67	61	56	53	26	9	22	14	205	30
16	203	220	193	179	224	238	192	61	345	49	49	49	67	81	226	205	225	219	224	254	225	238	229	212	211
17	212	208	205	211	211	214	213	208	213	216	336	265	254	240	239	248	245	244	224	211	255	230	225	240	230
18	234	224	230	227	229	230	237	243	249	245	252	251	28	1	145	294	255	251	240	245	246	222	38	212	243
19	234	244	260	250	250	247	248	248	254	251	256	262	15	42	353	324	163	198	201	304	196	217	214	234	248
20	248	245	240	246	245	234	233	219	212	201	201	211	258	267	262	249	244	255	264	195	216	217	242	240	235
21	218	217	241	228	236	81	19	34	209	135	84	112	60	301	210	61	111	68	19	54	264	255	245	242	180
22	304	229	247	255	216	233	222	211	228	262	350	341	111	27	61	148	244	12	310	252	255	242	243	254	255
23	261	261	254	251	242	240	245	248	247	255	257	260	265	264	266	265	268	264	289	266	252	255	241	241	256
24	236	229	226	232	244	244	239	233	214	258	271	295	289	300	291	349	17	8	26	320	224	177	337	199	266
25	229	330	0	21	342	174	20	77	37	36	354	59	56	53	65	65	66	62	45	24	39	199	229	225	38
26	225	360	313	37	354	16	8	39	1	3	23	65	82	167	3	331	56	81	45	290	221	211	204	219	11
27	312	13	47	1	282	241	239	211	220	237	280	280	271	275	277	274	267	278	271	302	248	236	214	147	267
28	226	255	228	239	239	244	242	226	215	221	259	264	280	275	277	278	278	292	296	236	178	226	215	221	246
29	238	194	51	173	227	225	179	189	217	210	202	205	207	232	240	246	231	218	215	202	202	207	204	204	211
30	232	260	261	293	319	61	77	49	93	279	257	206	265	273	269	276	276	276	306	44	14	281	257	250	283
AVG.	248	255	274	265	259	249	252	210	236	243	282	250	336	318	294	291	267	272	314	293	243	242	246	230	

Valid Hrs: 720    Completeness: 100.0%





BISON ENGINEERING INC.  
HELENA, MONTANA

Envirocon, Site #1

Livingston, MT

May 1992

\* \* \* \* \* WIND DIRECTION \* \* \* \*

DAY	HOUR																								AVG.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
1	251	263	280	287	297	304	276	270	262	259	261	263	254	267	257	264	266	258	262	245	232	192	239	232	260
2	243	233	244	241	237	240	232	213	214	207	215	228	275	274	277	273	273	263	249	293	211	217	210	220	241
3	265	212	15	292	202	227	132	54	219	232	277	275	259	259	271	278	315	256	282	249	212	94	301	196	254
4	203	37	53	24	61	118	67	218	220	223	212	207	257	252	249	249	259	264	259	202	217	213	236	73	226
5	5	56	38	30	62	78	69	207	224	232	241	1	56	14	55	85	73	62	39	359	137	208	209	221	58
6	136	23	80	165	173	239	232	230	230	229	230	228	225	204	238	272	284	264	247	260	285	314	217	237	235
7	32	2	298	85	125	239	222	208	208	209	252	260	262	250	302	305	266	353	311	229	358	213	211	325	266
8	356	47	38	49	238	254	203	209	221	256	273	261	254	268	59	209	227	217	214	234	205	214	193	216	233
9	250	346	336	347	250	255	250	242	256	259	253	255	255	246	74	161	35	346	360	77	278	225	244	247	272
10	270	240	238	233	239	232	219	212	206	205	199	209	211	212	213	215	217	212	213	246	18	75	327	342	228
11	289	1	59	11	335	54	356	8	358	266	296	271	271	277	278	282	277	349	1	344	343	290	256	38	324
12	24	342	321	50	13	215	219	86	105	35	56	75	56	55	48	48	50	54	52	49	54	50	68	73	50
13	12	148	10	210	212	226	37	48	34	20	11	207	205	256	276	262	271	271	260	274	231	249	259	239	265
14	243	239	242	245	242	240	237	230	253	275	285	286	289	285	271	278	263	252	276	315	247	194	192	338	259
15	213	226	221	329	221	218	218	212	205	198	191	213	230	199	208	208	241	225	217	239	345	48	15	10	225
16	12	335	337	120	305	342	80	118	88	227	260	274	263	252	190	222	204	264	155	292	202	260	98	34	256
17	26	45	201	46	177	220	201	216	220	205	207	203	227	244	283	216	150	259	265	252	187	206	216	209	217
18	216	244	213	210	237	226	205	207	203	197	210	199	271	260	285	254	239	269	19	253	185	191	217	299	231
19	72	270	121	359	86	337	71	60	45	32	51	63	78	94	233	227	192	203	178	205	229	241	242	229	130
20	242	334	327	18	63	240	71	184	212	207	196	202	205	199	204	254	287	340	254	279	296	351	25	23	264
21	45	31	36	45	53	51	76	65	64	66	64	70	67	68	65	66	65	58	58	61	60	52	51	59	58
22	63	57	51	53	52	62	63	62	69	75	80	78	68	65	50	50	51	51	50	35	17	346	346	42	52
23	4	158	221	234	299	339	75	61	55	55	52	35	78	58	67	64	61	69	66	58	348	359	20	288	42
24	251	168	5	358	191	214	167	14	32	56	60	59	57	63	68	67	61	57	59	59	61	59	52	33	58
25	14	12	16	62	54	68	76	66	67	63	58	66	51	47	55	59	56	51	47	42	16	344	190	211	50
26	207	201	223	3	69	115	192	168	205	213	239	251	212	68	64	46	43	343	52	4	327	261	258	238	228
27	224	225	217	229	233	284	109	269	214	224	228	222	326	191	200	234	213	357	90	158	293	219	208	259	227
28	215	232	240	243	235	244	210	209	208	157	34	269	267	254	245	356	26	14	35	65	76	82	70	23	254
29	161	0	198	289	180	51	5	203	233	265	262	266	226	233	242	240	208	193	201	88	196	263	172	209	223
30	217	245	251	243	242	244	232	218	217	205	242	241	15	14	270	343	356	354	33	193	222	233	246	244	252
31	238	236	239	242	239	224	228	283	265	264	281	320	222	244	246	316	342	353	17	57	23	199	215	221	262
AVG.	269	298	298	332	225	244	174	200	213	225	249	247	255	254	261	268	287	312	335	293	275	238	231	271	

Valid Hrs: 744    Completeness: 100.0%





BISON ENGINEERING INC.  
HELENA, MONTANA

Envirocon, Site #1

Livingston, MT

June 1992

\* \* \* \* \* WIND DIRECTION \* \* \* \*

DAY	HOUR																								AVG.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
1	209	142	56	28	52	78	213	230	232	226	200	193	230	206	264	223	242	247	223	211	198	215	168	96	206
2	357	67	68	237	252	241	232	211	223	226	222	253	11	79	57	33	219	209	212	201	193	173	195	226	216
3	243	240	230	300	246	241	236	248	260	268	262	255	267	264	254	257	252	250	249	288	159	13	348	177	255
4	203	222	66	80	51	40	47	216	238	267	280	279	278	293	337	33	27	14	294	323	108	68	31	356	347
5	354	318	326	31	8	339	212	40	26	314	240	197	214	207	260	344	83	57	43	56	80	3	303	210	348
6	220	216	20	164	352	65	47	49	48	73	98	92	59	58	56	168	205	202	196	192	178	216	200	235	132
7	188	60	20	344	40	44	110	217	223	221	216	159	186	346	348	30	64	200	213	180	199	210	224	79	176
8	41	0	41	68	42	344	56	108	290	137	148	117	110	130	197	199	205	149	168	52	298	163	33	354	94
9	6	351	58	51	11	6	9	200	191	185	159	179	184	184	187	199	203	222	195	193	223	195	218	232	196
10	228	230	219	168	221	224	225	228	210	204	206	185	201	125	109	86	91	152	197	220	203	198	198	220	196
11	213	204	197	224	225	202	202	202	189	214	82	57	75	122	204	252	222	164	207	177	42	258	231	269	201
12	230	209	229	229	37	220	122	71	67	80	58	66	65	65	72	52	69	69	59	80	76	81	64	134	82
13	180	222	223	213	226	226	223	205	209	214	227	215	209	213	221	214	216	244	268	261	276	148	338	216	223
14	174	261	144	57	349	12	18	58	68	55	63	69	83	78	70	69	73	41	29	18	40	52	53	57	55
15	64	71	75	69	59	85	65	74	84	84	89	48	340	108	2	346	303	180	169	217	221	215	197	218	86
16	216	215	221	212	213	216	214	211	208	207	204	202	212	209	208	210	200	206	217	212	212	218	229	222	212
17	218	219	219	217	223	214	216	217	214	212	210	206	222	208	209	221	218	250	245	256	229	216	240	246	223
18	231	227	217	204	232	239	231	233	230	288	29	56	19	20	55	82	36	53	63	69	86	76	63	8	48
19	349	235	187	183	200	163	53	224	29	71	63	39	39	45	55	51	47	106	225	343	178	202	339	105	81
20	319	28	15	106	37	237	238	227	221	219	209	129	63	60	53	69	91	107	90	241	190	228	219	229	158
21	230	217	236	240	225	243	199	211	208	212	204	229	243	10	353	294	88	66	74	65	44	10	36	186	226
22	207	235	206	196	69	179	185	216	221	223	226	321	37	31	347	275	352	14	67	41	17	273	166	188	236
23	355	340	220	67	29	355	47	73	212	228	222	250	283	265	268	279	290	326	265	201	205	230	208	240	266
24	190	41	51	66	65	54	59	29	32	56	55	47	48	47	54	66	133	125	139	70	55	51	56	68	64
25	84	71	27	25	1	358	30	66	68	77	75	56	52	53	52	67	198	199	185	185	241	225	281	254	60
26	236	246	228	229	104	22	82	67	47	80	63	45	23	93	105	148	203	190	191	192	198	195	199	195	150
27	202	195	201	204	204	201	208	210	208	198	207	215	239	352	235	201	295	134	70	292	179	213	259	191	212
28	166	115	168	239	283	344	78	138	23	45	39	46	61	52	57	52	58	56	43	57	148	24	49	53	61
29	29	40	44	61	70	60	70	78	74	74	74	72	65	55	50	62	162	177	177	248	213	233	218	227	83
30	219	184	230	349	347	164	31	349	40	2	12	100	75	10	159	212	206	221	237	308	19	90	174	221	279
AVG.	222	222	188	163	6	269	131	183	201	192	161	128	63	67	51	91	174	165	189	220	179	198	222	209	

Valid Hrs: 720    Completeness: 100.0%





BISON ENGINEERING INC.  
HELENA, MONTANA

Envirocon, Site #1

Livingston, MT

April 1992

\* \* \* \* \* WIND SIGMA \* \* \* \*

DAY	HOUR																								AVG.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
1	30	27	45	79	17	36	64	14	15	16	16	48	30	44	41	43	49	35	22	38	29	62	18	30	35
2	55	72	32	50	32	34	14	13	16	12	12	14	26	14	16	14	16	20	15	16	46	56	22	9	26
3	12	9	11	10	12	14	11	10	12	15	15	13	28	27	16	19	24	38	37	25	52	42	20	72	23
4	64	84	25	36	29	82	73	48	64	38	73	74	13	49	76	55	21	79	61	77	75	25	20	67	55
5	41	78	42	13	39	37	60	31	23	12	15	15	24	15	13	10	10	32	11	53	39	60	14	21	30
6	35	55	24	56	35	14	18	14	13	24	44	14	12	13	13	37	11	16	16	12	16	76	27	8	25
7	7	7	9	6	25	7	12	9	10	18	19	28	15	15	13	14	8	9	51	55	28	28	66	28	20
8	40	39	18	18	9	63	28	69	23	78	33	50	63	64	50	44	13	10	38	50	71	54	16	12	40
9	13	11	12	14	12	9	18	12	14	14	15	14	22	19	17	22	66	11	13	45	39	28	73	36	23
10	25	9	23	32	32	23	15	16	13	12	13	49	46	30	10	12	12	16	19	70	28	52	61	62	28
11	40	66	77	56	15	11	10	10	9	10	10	11	11	10	11	10	11	11	11	10	10	10	11	10	19
12	11	10	19	22	17	13	31	71	58	61	76	55	74	59	29	68	14	17	52	20	87	51	34	62	42
13	35	74	77	76	89	65	59	80	26	19	18	30	31	57	12	14	10	14	43	73	78	63	60	35	47
14	41	66	26	25	11	52	30	69	66	63	65	53	46	55	34	33	23	13	13	24	14	23	18	17	37
15	17	18	24	67	78	58	40	46	29	62	19	14	12	13	12	11	11	13	11	20	13	26	49	40	29
16	17	26	56	35	12	7	70	61	42	32	28	19	18	42	38	31	20	15	31	26	17	31	27	13	30
17	13	11	12	12	13	12	12	11	19	30	26	49	12	11	12	13	13	14	20	17	17	16	17	17	17
18	9	14	12	11	9	12	12	10	9	9	8	8	68	59	76	71	13	14	10	10	11	16	70	41	24
19	8	10	41	9	10	9	9	11	9	9	13	20	90	24	15	34	67	18	44	35	14	17	23	12	23
20	8	8	19	10	9	16	15	12	11	17	15	26	19	15	17	14	13	12	14	42	11	45	13	34	17
21	59	31	10	15	11	72	64	26	47	82	54	42	59	38	68	74	32	12	26	68	9	8	17	64	41
22	35	45	18	29	25	11	16	14	14	35	17	33	70	32	24	70	26	58	34	32	10	10	13	11	28
23	9	13	8	9	9	11	11	10	9	10	13	14	13	15	14	13	15	11	11	15	14	14	13	16	12
24	11	11	10	8	8	8	8	11	21	23	30	33	51	68	46	37	24	19	15	49	33	81	60	42	29
25	26	20	24	24	15	69	53	38	28	41	76	41	41	26	21	19	16	12	13	24	61	40	12	11	31
26	16	66	57	63	32	38	25	23	21	26	29	47	42	49	47	85	26	13	41	63	77	62	27	45	43
27	68	71	36	67	52	18	54	12	15	25	13	13	13	17	10	11	11	8	11	17	34	36	14	59	29
28	55	29	12	9	8	7	8	12	12	20	19	20	17	16	18	12	11	13	9	67	42	39	53	12	22
29	84	47	65	71	36	35	13	32	34	12	11	14	18	30	22	16	14	15	14	13	13	11	10	11	27
30	19	30	28	29	49	86	24	24	34	44	37	13	15	11	11	10	9	9	32	61	61	70	15	11	31
AVG.	30	35	29	32	25	31	29	27	24	29	28	29	33	31	27	31	20	19	25	38	35	38	30	30	

Valid Hrs: 720      Completeness: 100.0%



BISON ENGINEERING INC.  
HELENA, MONTANA

Envirocon, Site #1

Livingston, MT

May 1992

\* \* \* \* \* WIND SIGMA \* \* \* \* \*

DAY	HOUR																								AVG
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
1	13	13	8	72	24	20	15	9	10	13	15	12	12	14	16	15	17	15	9	11	19	46	9	40	19
2	10	9	8	12	10	14	16	10	12	14	22	40	14	12	13	15	15	15	14	14	38	72	28	29	41
3	69	85	63	81	63	50	74	62	13	22	14	12	12	14	14	33	33	16	27	80	18	76	77	27	43
4	35	28	25	24	37	56	44	62	12	14	20	35	20	15	13	12	13	9	40	26	11	59	71	46	30
5	22	24	22	27	31	49	18	62	15	14	24	68	60	41	41	23	13	11	15	12	68	16	13	15	29
6	63	30	66	67	51	10	12	12	11	14	13	24	37	35	21	45	37	13	28	73	49	79	70	61	38
7	61	48	88	64	73	8	14	10	11	12	15	13	15	16	36	38	30	20	16	79	80	36	15	78	37
8	75	34	29	63	13	16	17	16	23	20	31	9	9	20	90	21	12	13	13	21	17	19	22	23	26
9	18	44	39	32	22	8	11	14	9	9	9	8	12	28	40	27	32	27	81	29	52	32	9	9	25
10	9	16	13	12	21	22	14	14	12	11	11	14	14	14	15	12	13	12	12	51	33	47	77	50	22
11	63	33	57	39	21	82	61	20	63	31	24	12	12	14	12	11	15	45	14	12	10	41	22	59	32
12	21	15	38	84	37	38	59	41	50	33	34	24	17	16	14	12	12	12	14	14	14	27	24	20	28
13	39	67	68	17	20	61	49	20	27	50	65	43	24	38	13	16	16	16	28	15	20	16	11	13	31
14	10	11	8	7	6	7	7	9	12	13	14	19	15	16	18	14	15	15	31	31	71	62	46	68	22
15	29	67	25	42	31	12	17	16	15	16	15	25	28	12	16	14	33	27	11	19	20	52	52	31	26
16	32	17	31	78	58	20	37	50	51	30	28	11	13	17	44	44	35	64	52	66	18	74	65	35	40
17	34	41	71	76	54	23	24	17	70	25	25	14	38	58	38	53	32	62	27	25	49	21	19	18	38
18	19	16	23	19	34	62	13	14	15	16	22	16	16	30	22	37	47	13	55	68	67	34	45	75	32
19	53	68	71	78	63	40	32	23	30	18	17	12	13	48	25	21	40	41	22	20	13	32	21	25	34
20	17	70	39	44	56	53	65	66	14	14	12	14	14	13	14	26	23	24	57	79	48	26	16	22	34
21	28	17	16	23	13	13	12	14	11	11	11	11	10	12	11	12	10	12	11	10	10	14	13	11	13
22	11	11	11	11	13	10	11	11	15	17	17	15	15	18	19	17	17	14	11	13	26	19	19	56	17
23	32	34	14	8	73	48	47	29	50	51	49	45	35	26	25	31	14	10	12	19	15	11	40	80	33
24	48	48	20	45	61	21	68	17	18	14	12	13	15	14	11	13	11	12	11	11	11	11	11	51	24
25	27	16	25	13	16	13	14	19	21	28	24	23	24	19	17	18	15	14	12	14	26	19	24	20	19
26	14	12	37	35	76	76	70	57	14	20	26	31	35	17	22	21	67	84	36	16	33	19	10	16	35
27	12	11	10	14	45	43	23	77	17	25	16	49	77	17	17	66	22	66	56	88	60	33	17	35	37
28	35	21	9	8	10	9	15	12	18	69	60	18	23	34	31	47	29	17	16	29	19	11	34	14	25
29	78	66	69	80	78	31	55	38	23	10	10	11	36	13	15	17	19	13	40	68	25	52	65	40	40
30	29	11	9	11	11	10	12	12	16	17	28	18	47	58	19	45	15	14	86	50	21	10	10	11	24
31	12	11	11	12	37	16	16	45	14	10	52	23	29	34	19	36	26	20	19	18	27	72	33	21	26
AVG.	33	32	33	39	37	30	30	28	22	21	24	22	24	24	23	26	23	24	28	36	33	35	32	36	36

Valid Hrs: 744      Completeness: 100.0%





BISON ENGINEERING INC.  
HELENA, MONTANA

Envirocon, Site #1

Livingston, MT

June 1992

\* \* \* \* \* WIND SIGMA \* \* \* \*

DAY	HOUR																								AVG.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
1	38	77	40	26	35	22	39	10	10	16	16	39	64	64	41	34	16	11	20	19	17	17	72	55	33
2	17	60	24	29	14	11	17	10	12	13	21	15	72	39	27	21	46	27	20	17	19	17	16	18	24
3	12	11	19	45	8	9	13	16	12	15	16	15	18	19	16	14	16	14	14	34	60	30	41	11	20
4	16	21	69	51	37	45	25	52	19	18	17	19	16	21	38	24	18	18	41	73	17	28	10	20	30
5	58	11	19	42	11	46	70	22	19	40	33	26	16	33	60	19	47	50	50	31	40	12	75	28	36
6	17	21	49	78	28	33	37	43	38	48	46	41	50	43	39	76	13	12	16	20	20	62	29	23	37
7	47	46	33	21	45	25	56	42	12	30	71	58	48	58	42	21	42	21	17	23	28	28	33	59	38
8	31	18	52	40	58	62	35	55	60	70	50	44	46	29	19	17	14	31	17	21	73	46	79	69	43
9	25	21	41	52	22	31	20	58	24	29	36	20	17	14	21	15	16	22	36	27	40	76	35	31	30
10	57	27	83	76	31	12	16	14	24	19	19	37	46	42	16	12	19	38	28	21	15	15	14	24	29
11	57	20	13	21	16	15	20	23	17	22	75	29	17	32	59	16	62	45	22	16	79	63	32	44	34
12	28	32	25	55	72	20	59	20	20	31	32	14	15	14	14	15	12	10	12	15	20	19	36	21	25
13	33	31	37	13	47	13	17	14	14	15	13	17	22	17	13	14	14	25	12	10	32	75	77	63	27
14	78	73	77	14	35	14	19	12	11	13	12	10	28	47	11	12	13	20	27	14	15	10	13	10	25
15	11	10	12	15	27	15	13	14	11	11	13	52	39	32	50	16	31	62	27	17	15	15	13	24	23
16	13	13	12	11	14	10	11	11	12	11	11	11	13	13	10	12	12	38	11	13	32	9	11	12	14
17	11	12	16	15	15	14	13	13	14	14	13	13	19	18	16	20	25	13	10	16	20	10	66	81	20
18	15	13	16	13	18	17	12	11	18	65	34	31	42	50	54	25	19	24	12	14	13	15	14	25	24
19	15	76	17	50	70	83	54	64	40	40	33	21	16	13	14	15	16	69	17	67	60	53	89	48	43
20	74	23	40	52	30	51	12	12	14	14	38	67	30	38	30	21	29	23	42	18	17	20	57	14	32
21	28	37	21	9	10	74	39	11	11	17	26	40	25	61	52	60	39	21	15	15	23	20	59	24	31
22	15	11	60	40	75	55	60	18	18	14	18	83	30	53	55	28	17	26	21	22	28	78	44	17	37
23	67	64	30	64	22	16	23	60	18	19	72	40	18	15	19	17	33	24	61	50	19	16	59	65	37
24	75	49	21	19	12	14	14	21	20	15	18	16	15	16	15	14	42	51	37	13	16	13	12	11	23
25	12	12	29	16	9	14	28	15	15	19	18	16	15	16	13	49	16	20	14	13	64	45	41	25	22
26	13	16	31	21	75	47	21	19	23	48	56	41	35	47	25	39	14	15	17	16	15	15	14	14	28
27	13	12	10	12	12	11	12	11	14	15	16	26	25	65	55	48	83	38	49	72	57	23	60	40	32
28	65	51	51	19	82	42	11	74	53	34	23	23	21	18	16	12	12	12	13	73	79	35	13	13	35
29	35	31	17	16	20	11	13	11	11	12	13	13	12	23	19	32	49	60	38	49	40	16	19	24	24
30	19	13	24	63	25	56	61	18	61	32	40	49	67	26	64	56	16	18	23	59	46	65	48	44	41
AVG.	33	30	33	33	33	30	28	26	22	25	30	31	30	33	31	26	27	29	25	29	34	32	39	32	

Valid Hrs: 720    Completeness: 100.0%



BISON ENGINEERING INC.  
HELENA, MONTANA

Envirocon, Site #1

Livingston, MT

April 1992

\* \* \* \* \* WIND FREQUENCY SUMMARY \* \* \* \* \*

DIR----> SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
0.0 - 4.0	3.1	3.8	1.6	0.8	0.6	0.2	0.4	0.9	2.2	1.6	1.2	0.8	0.4	0.9	1.3	2.9	23.6
4.0 - 7.5	2.3	3.4	1.8	0.6	0.5	0.2	0.2	0.4	1.2	4.3	2.3	1.1	1.2	0.4	0.1	1.6	22.3
7.5 - 12.1	0.5	1.8	2.3	0.1	0.0	0.0	0.1	0.1	1.6	6.3	7.2	2.5	0.9	0.5	0.9	0.9	26.3
12.1 - 19.0	0.0	0.1	3.4	0.0	0.0	0.0	0.0	0.1	3.0	4.0	7.6	4.4	0.9	0.1	0.1	0.1	24.3
19.0 - 24.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.1	1.5	0.0	0.0	0.0	0.0	2.5
24.7 - 30.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.8
30.0 - 40.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40.0 - 50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Over 50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	6.1	9.3	9.3	1.6	1.2	0.5	0.8	1.6	9.3	16.3	18.6	10.9	3.6	2.0	2.6	5.6	
AVG. SPEED	4.7	5.4	9.4	4.5	4.2	4.0	4.8	4.8	11.4	9.6	11.3	13.9	9.0	6.6	5.6	4.9	

Calm Hours = 0.0%      Hours With Both Speed and Direction = 720      Mean Wind Speed = 9.1 (MPH)      Resultant Wind Direction = 262





BISON ENGINEERING INC.  
HELENA, MONTANA

Envirocon, Site #1

Livingston, MT

May 1992

\* \* \* \* \* WIND FREQUENCY SUMMARY \* \* \* \* \*

DIR----> SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
0.0 - 4.0	1.0	2.0	1.7	1.0	0.9	0.2	1.0	0.6	2.0	1.3	0.6	0.9	1.7	0.0	1.2	2.4	19.2
4.0 - 7.5	2.6	3.0	2.2	0.5	0.0	0.2	0.5	0.6	3.3	3.4	1.4	1.0	0.6	0.8	1.3	1.0	23.3
7.5 - 12.1	1.2	3.0	4.1	0.1	0.0	0.0	0.0	0.5	3.7	6.3	7.5	2.9	0.8	0.6	0.9	0.4	32.5
12.1 - 19.0	0.0	1.6	3.3	0.1	0.0	0.0	0.0	0.0	2.4	2.2	3.7	4.9	0.6	0.1	0.4	0.2	20.0
19.0 - 24.7	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	1.6	0.5	0.4	1.0	0.0	0.0	0.0	0.2	4.0
24.7 - 30.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.8
30.0 - 40.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40.0 - 50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Over 50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	4.9	9.8	11.6	1.8	0.9	0.5	1.6	1.8	13.7	13.9	13.8	11.1	4.0	1.6	3.8	4.4	
AVG. SPEED	6.0	7.9	10.1	5.1	3.5	4.5	3.5	6.0	11.0	9.3	10.8	13.3	7.8	7.6	7.0	5.8	

Calm Hours = 0.0%      Hours With Both Speed and Direction = 744      Mean Wind Speed = 9.4 (MPH)      Resultant Wind Direction = 255



BISON ENGINEERING INC.  
HELENA, MONTANA

Envirocon, Site #1

Livingston, MT

June 1992

\* \* \* \* \* WIND FREQUENCY SUMMARY \* \* \* \* \*

DIR---->	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
SPEED (MPH)																	
0.0 - 4.0	1.8	3.3	2.3	1.3	0.8	0.6	1.6	2.0	1.6	1.3	0.6	0.4	0.5	0.2	0.9	1.2	21.3
4.0 - 7.5	2.2	2.3	2.6	1.5	1.1	0.5	0.8	1.2	2.9	4.3	0.8	0.9	0.4	0.6	0.9	2.6	26.2
7.5 - 12.1	1.5	2.9	4.4	0.8	0.2	0.4	0.6	1.3	7.2	9.1	3.4	0.2	0.8	0.1	0.2	0.4	34.3
12.1 - 19.0	0.0	2.2	3.3	0.4	0.0	0.0	0.0	0.5	4.5	2.7	0.9	1.6	0.2	0.0	0.1	0.0	16.9
19.0 - 24.7	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.1	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.9
24.7 - 30.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1
30.0 - 40.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40.0 - 50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Over 50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	5.5	10.9	13.0	4.1	2.2	1.6	3.1	5.2	16.5	18.1	5.9	3.3	2.0	1.1	2.3	4.3	
AVG. SPEED	5.8	8.0	9.4	6.6	5.3	6.0	4.8	6.8	10.3	9.5	9.6	10.5	7.3	5.0	5.5	5.3	

Calm Hours = 0.0%      Hours With Both Speed and Direction = 720      Mean Wind Speed = 8.4 (MPH)      Resultant Wind Direction = 183





# BISON ENGINEERING INC. HELENA, MONTANA

Envirocon, Site #1

Livingston, MT

2nd Quarter 1992

## \* \* \* \* \* WIND FREQUENCY SUMMARY \* \* \* \* \*

DIR--->	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
SPEED (MPH)																	
0.0 - 4.0	2.0	3.0	1.9	1.0	0.8	0.4	1.0	1.2	1.9	1.4	0.8	0.7	0.9	0.4	1.1	2.1	21.3
4.0 - 7.5	2.4	2.9	2.2	0.9	0.5	0.3	0.5	0.7	2.5	4.0	1.5	1.0	0.7	0.6	0.8	1.7	23.9
7.5 - 12.1	1.0	2.6	3.6	0.3	0.0	0.1	0.2	0.6	4.2	7.2	6.0	1.9	0.8	0.4	0.7	0.5	31.0
12.1 - 19.0	0.0	1.3	3.3	0.1	0.0	0.0	0.0	0.2	3.3	3.0	4.1	3.7	0.6	0.0	0.2	0.1	20.4
19.0 - 24.7	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.8	0.3	0.1	0.8	0.0	0.0	0.0	0.0	2.5
24.7 - 30.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.5
30.0 - 40.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40.0 - 50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Over 50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	5.5	10.0	11.3	2.5	1.4	0.9	1.8	2.9	13.1	16.1	12.8	8.5	3.2	1.6	2.9	4.8	
AVG. SPEED	5.4	7.2	9.7	5.7	4.6	5.3	4.4	6.3	10.8	9.5	10.8	13.2	8.1	6.6	6.2	5.3	

Calm Hours = 0.0%      Hours With Both Speed and Direction = 2184      Mean Wind Speed = 9.0 (MPH)      Resultant Wind Direction = 244



## **APPENDIX B**





**BISON ENGINEERING, INC.**  
Helena, MT

**PM10 CALIBRATION**

Calibrated by Dan McCaffery Location Livingston Railyard

Date 6/4/92 Sampler No. Upwind, #1

Field Use	
Orifice I.D. Number <u>S48-ECO</u>	Temperature (K) <u>292.2</u>
20" U-Tube Manometer <u>21.5</u> (" H <sub>2</sub> O = Δ)	Barometric Pressure <u>25.43</u> (" Hg = P <sub>0</sub> )
10" Manometer <u>4.1</u> (" H <sub>2</sub> O = dP) [Clean Filter]	Clean Filter Transducer _____ (acfm)
Notes _____	
_____	
_____	

Look Up
P <sub>1</sub> /P <sub>0</sub> (P <sub>1</sub> = P <sub>0</sub> - Δ/13.6) = <u>0.938</u>
ACFM = <u>40.10</u>
SCFM = $ACFM \left( \frac{P_0 * 298}{29.92 * T_k} \right)$ <u>34.76</u>

Orifice
Q = A * (dP) <sup>0.5</sup> = <u>1.017</u> (m <sup>3</sup> /min)
Q <sub>cfm</sub> = Q * 35.314 = <u>35.93</u> (acfm)r
Q <sub>scfm</sub> = $Q_{cfm} \left( \frac{P_0 * 298}{29.92 * T_k} \right)^{0.5}$ <u>33.45</u> (scfm)
% Difference <u>3.9</u> Adjustment _____

Last EPA/State Calibration: Date 6/5/91

A = 0.4998 B = 0.50378



**BISON ENGINEERING, INC.**  
Helena, MT

**PM10 CALIBRATION**

Calibrated by Dan McCaffery Location Livingston Railway

Date 6/4/91 Sampler No. Downwind, #2

Field Use	
Orifice I.D. Number <u>S48-ECO</u>	Temperature (K) <u>292.2</u>
20" U-Tube Manometer <u>21</u> (" H <sub>2</sub> O = Δ)	Barometric Pressure <u>25.43</u> (" Hg = P <sub>0</sub> )
10" Manometer <u>4.0</u> (" H <sub>2</sub> O = dP) [Clean Filter]	Clean Filter Transducer _____ (acfm)
Notes _____	
_____	
_____	

Look Up
P <sub>1</sub> /P <sub>0</sub> (P <sub>1</sub> = P <sub>0</sub> - Δ/13.6) = <u>0.939</u>
ACFM = <u>39.95</u>
SCFM = $ACFM \left( \frac{P_0 * 298}{29.92 * T_k} \right)$ <u>34.65</u>

Orifice
Q = $A * (dP)^B$ = <u>1.005</u> (m <sup>3</sup> /min)
Q <sub>cfm</sub> = $Q * 35.314$ = <u>35.49</u> (acfm)r
Q <sub>scfm</sub> = $Q_{cfm} \left( \frac{P_0 * 298}{29.92 * T_k} \right)^{0.5}$ <u>33.05</u> (scfm)
% Difference <u>4.8</u> Adjustment _____

Last EPA/State Calibration: Date 6/5/91

A = 0.4998 B = 0.50378





**BISON ENGINEERING, INC.**  
Helena, MT

**PM10 AUDITING**

Audited by J. Hall Location Envirocon, Livingston  
Date 6-9-92 Sampler No. #1, Upwind

Field Use	
Orifice I.D. Number <u>E32</u>	Temperature (°F) <u>78.2</u>
10" Manometer <u>2.85</u> (" H <sub>2</sub> O = dP) [Clean Filter]	Barometric Pressure <u>24.98</u> (" Hg = P <sub>0</sub> )
Clean Filter Transducer _____	(acfm)
Notes <u>20" Manometer 19.4 in H2O,</u>	
<u>Clean filter 19.4 in H2O</u>	

Look Up	
P <sub>1</sub> /P <sub>0</sub> (from previous calibration) = <u>0.943</u>	
ACFM = <u>41.010</u>	
SCFM = $ACFM \left( \frac{P_0 * 298}{29.92 * T_k} \right)$ <u>34.159</u>	

Orifice	
$Q = A * (dP)^B =$ <u>1.053</u>	(m <sup>3</sup> /min)
$Q_{cfm} = \rho * 35.314 =$ <u>37.198</u>	(acfm)r
$Q_{scfm} = Q_{cfm} \left( \frac{P_0 * 298}{29.92 * T_k} \right)^{0.5}$ <u>33.949</u>	(scfm)
$Q_{acfm} = Q_{cfm} \left( \frac{P_0 * 298}{29.92 * T_k} \right)^{-0.5}$ <u>40.758</u>	(acfm)
% Difference <u>0.6</u> (from SCFM)    % Difference <u>1.9</u> (from 40 ACFM)	

Last EPA/State Calibration:    Date July 8, 1991  
Audit Orifice No. E32    A = 0.62972    B = 0.49122



**BISON ENGINEERING, INC.**  
Helena, MT

**PM10 AUDITING**

Audited by J. Hall Location Envirocon, Livingston

Date 6-9-92 Sampler No. #2, Downwind

Field Use	
Orifice I.D. Number <u>E32</u>	Temperature (°F) <u>77.7</u>
10" Manometer <u>2.9</u> (" H <sub>2</sub> O = dP) [Clean Filter]	Barometric Pressure <u>25.05</u> (" Hg = P <sub>0</sub> )
Clean Filter Transducer _____	(acfm)
Notes <u>20" Manometer 19.2 in H2O,</u>	
<u>Clean filter 19.2 in H2O</u>	

Look Up	
P <sub>1</sub> /P <sub>0</sub> (from previous calibration) = <u>0.944</u>	
ACFM = <u>41.09</u>	
SCFM = $ACFM \left( \frac{P_0 * 298}{29.92 * T_k} \right)$ <u>34.36</u>	

Orifice	
$Q = A * (dP)^B =$ <u>1.062</u>	(m <sup>3</sup> /min)
$Q_{cfm} = Q * 35.314 =$ <u>37.517</u>	(acfm)r
$Q_{scfm} = Q_{cfm} \left( \frac{P_0 * 298}{29.92 * T_k} \right)^{0.5}$ <u>34.305</u>	(scfm)
$Q_{scfm} = Q_{cfm} \left( \frac{P_0 * 298}{29.92 * T_k} \right)^{-0.5}$ <u>41.038</u>	(acfm)
% Difference <u>0.2</u> (from SCFM)    % Difference <u>2.6</u> (from 40 ACFM)	

Last EPA/State Calibration:    Date July 8, 1991

Audit Orifice No. E32    A = 0.62972    B = 0.49122





## COLLOCATED PM10 AIR SAMPLER PRECISION ANALYSIS

Rosebud Energy Project

Second Quarter - 1992

Date	Reporting Sampler Conc. (ug/M <sup>3</sup> )	Collocated Sampler Conc. (ug/M <sup>3</sup> )	D(%)
04/06/92	4.4	4.2	-4.7
04/12/92	29.2	31.3	6.9
04/18/92	49.8	56.9	13.3
04/24/92	5.7	5.8	1.7
04/30/92	11.1	10.4	-16.5
05/06/92	23.3	21.9	-6.2
05/12/92	8.5	11.6	30.8
05/18/92	46.3	45.5	-1.7
05/24/92	8.7	8.6	-1.2
05/30/92	8.5	8.5	0.0
06/05/92	7.1	5.7	-21.9
06/11/92	23.9	24.5	-19.7
06/17/92	9.3	4.6	-6.8
06/23/92	54.9	55.2	0.5
06/29/92	21.6	21.4	-0.9

$$D\% = \frac{(Y_i - X_i)}{\frac{(Y_i + X_i)}{2}} \times 100$$

No. Samples = 15  
Average D (  $\bar{D}$  ) = -1.76  
Std. Dev. (SD) = 13.04  
Probability Limits:

$$\bar{D} - 1.96 \left( \frac{SD}{\sqrt{2}} \right) = -19.84$$

$$\bar{D} + 1.96 \left( \frac{SD}{\sqrt{2}} \right) = 16.32$$







